WAVETEK

OPERATOR'S MANUAL
& APPLICATIONS GUIDE

LANTech™ 100

LAN/Telecom Cable Tester

Version 2.0

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As a member of the LANTech Users Group, you will receive a complimentary PC Interface cable. This DB9 to DB9 Null Modem cable (a retail value of $6.00) will allow you to download test results into your IBM/AT™ compatible serial port.

LANTech Users Group members also are entitled to technical assistance via the *24 hour BBS* or from the *Wavetek Customer Technical Support Hotline.*

If you ever have a question on the use or operation of the LANTech, please do not hesitate to call **1-800-223-9885** and ask for LANTech Technical Support.

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& APPLICATIONS GUIDE

LANTech™ 100
LAN/Telecom Cable Tester

Version 2.0

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One Year Limited Warranty

The LANTech 100 is warranted against defects in parts, material, and workmanship for a period of one (1) year following the date of purchase of the tester by the original buyer. This warranty is extended by Wavetek only to the original buyer or original user of the instrument who must present proof of purchase at the time of warranty service.

In the United States any LANTech 100 claimed to be defective during the warranty period should be returned with proof of purchase to Wavetek's Factory Service Center.

ANY IMPLIED WARRANTIES ARISING OUT OF THE SALE OF A LANTech 100 INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE ABOVE STATED ONE (1) YEAR PERIOD. MANUFACTURER SHALL NOT BE LIABLE FOR LOSS OF THE USE OF THE TESTER OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, OR ECONOMIC LOSS.

Some states do not allow limitations on how long implied warranties last or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Certification

Wavetek certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when shipped from the factory.

Specifications are subject to change without notice.

Important User Information

Please read this information before proceeding with any cable testing/certification using the LANTech 100 Cable Tester.

All the cable parameter default settings preprogrammed in the LANTech 100 are based on generic standards, proposed industry recommendations for cables and network links, the latest technical information available from EIA/TIA committees, the LAN industry and Wavetek's own experience and testing. However, the default settings in the LANTech 100 may not yield the desired certification/test results in every given instance because each network is a custom installation designed to suit the requirements of the users. It is therefore imperative that specific network parameter limits be obtained from the network designer(s) and employed during certification and testing.

Refer to Section 2 "Selecting Cable Type" for information and instructions on how to select the correct cable type, change testing methods, and customize that cable's parameters for certification and testing. Appendix A provides a complete list of preprogrammed cable types and their default parameter settings.

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Version Changes

Version Change Descriptions

1. Quick Test has been added to provide a rapid and reliable installation check and diagnostic tool (run time of 45 seconds).

2. Autotest method has been changed to meet new testing criteria being proposed by EIA/TIA for fully certifying Crosstalk (run time 90 seconds).

3. Test Storage has been increased from 100 to 150 tests to provide storage for an 8-hr work day's worth of data.

4. Cable type TP-DDI Category 5 (US equivalent = TP-PMD) has been added to the standard Cable Types menu for convenient testing of pairs 1,2 and 7,8.

5. Attenuation-to-Crosstalk Ratio (ACR) has been integrated into the pass/fail criteria for EIA/TIA Category cables.

6. A red "Charging" LED has been added to both AXT's to indicate that charging power is applied.

7. Graphic printouts have been enhanced to include testing limit lines and to show the new logarithmic sweep pattern.

8. Autotest and Quick Test now performs loop resistance on all four pairs automatically and prints each pair's results.

9. A serial printer cable and Wavetek's Handbook of LAN Cable Testing is included in the all new carrying case.

Getting Started/Initial Setup

1.1 Unpacking

The LANTech™ 100 package should include the following items:

Qty	Description
1	LT-100 Cable Tester.
1	AXT-110 Smart Terminator™
1	AXT-111 NEXT Injector with Holster and Carry Strap.
2	Battery Eliminators/Chargers.
1	RJ-45 Coupler 8MJ/8MJ.
1	Charging Interconnect Cable. (LT-100 to AXT-111).
1	RJ-45 to RJ-45 Patch Cable.* (7 feet long)
1	RJ-45 to DB25 Patch Cable.* (6 feet long)
1	RJ-45 to DB25 Patch Cable.* (3 feet long)
1	Operator's Manual.
1	Handbook of LAN Cable Testing.
1	Serial Printer Interface Cable (DB9/DB25)

NOTE: *The patch cables supplied with your LANTech 100 system have been tested and certified to EIA/TIA 568 Catagory 5 standards. More important, they are characterized in the tester's firmware to eliminate adding to the system under test. Using any other patch cables other than those specifically approved by Wavetek may result in erroneous test results. Refer to Section 9 for replacement patch cables.*

If your system is missing any of the above items, please contact your Wavetek distributor for immediate replacement.

1.2 General Description

The LANTech 100 is a portable, hand-held test instrument designed for metallic data communications cable certification, analysis, and evaluation. LANTech 100 operates either sequenced automatically (Autotest or Quick Test Mode), or individually under operator control (Diagnostic Mode).

Two integral interface connectors allow attachment to coaxial and twisted pair media. Electrical testing is accomplished by following the operator prompts. The instruments' test results appear on a four-line, 16 character LCD display. The available tests are:

Line Mapping
On twisted pair media (STP, UTP), up to eight lines are monitored and measured for end-to-end connectivity as well as shorts, opens, or miswires. Continuity testing of shielded cable can be accomplished using CA-STP100 Shielded Cable Adapters.

DC Resistance
A measure of the combined resistance of a coaxial shield and center conductor, or two conductors in a twisted pair cable. Resolves to 0.1Ω to detect open or short circuits. This test constantly updates to facilitate intermittent problem detection.

Noise
Both Transient and Average (RMS) electrical noise is measured on both coaxial and twisted pair media. RMS noise can be measured in three bands spanning 40 Hz to 100 MHz. Transient noise has an adjustable minimum threshold.

Length
Distance to an impedance mismatch (short, open, or high resistance circuit) can be measured with a displayed and stored resolution (not to be confused with accuracy) of 1 foot (English measurment) or 0.1m (Metric measurment) using time-domain reflectometry.

Refer to Section 8 for detailed specifications concerning cable types, minimum and maximum lengths, and accuracy. The readout can be user selected to Metric (m) or English (ft.) units.

Attenuation

In conjunction with the AXT-110 Smart Terminator and AXT-111 NEXT Injector, measures cable loss in dB over the range of 500 kHz through 100 MHz, in microsteps of 500 kHz. This test will also produce a printed graph when executed in the Diagnostic Mode.

Office Identification

With the use of IT-2 Intelligent Terminators that are attached to the far ends of twisted pair cables, the LT-100 is able to identify the corresponding cable ends at the wiring closet. The IT-2's respond with a number (1 thru 8) and the AXT-110 responds with the letter A.

Near-End Crosstalk

Performed in conjunction with the AXT-110 Smart Terminator and the AXT-111 NEXT Injector, will determine the amount of crosstalk present in the frequency range of 100 kHz to 100 MHz. This test will also produce a printed graph when executed in the Diagnostic Mode.

Capacitance

On twisted pair media (STP, UTP) a measurment of mutual capacitance between conductors in a pair is made and compared to maximum limits established by EIA/TIA 568 and UL. Mutual capacitance between the conductor and shield of coax cable can also be measured.

Attenuation-to-Crosstalk Ratio (ACR)

An Attenuation-to-Crosstalk Ratio calculation is presented with the test results. This is not an independent test, but when both Attenuation and Crosstalk tests are performed on a cable pair, the greatest reading for each test is subtracted to give a ACR result.

Some testing requires accessories not supplied with the LANTech 100 System Refer to specific test instructions and Section 9 for available accessories.

Test results obtained during Autotest and Quick Test are automatically compared with factory preset or user programmed high and low limits, providing a quick Pass/Fail evaluation of the cable under test. Refer to Appendix A for factory preset values, Section 2 for standard/custom cable selections, and Section 9 for a complete list of accessories.

1.3 Hardware Description

The LANTech 100 Cable Tester System is composed of three major units: The LT-100 Hand Held Tester, the AXT-110 Smart Terminator, and the AXT-111 NEXT Injector. All three units are powered by rechargable 7.2 volt Nicad battery packs. The system includes two AC Chargers/Eliminators for recharging the units or for operating while connected to an AC outlet.

CAUTION: Refer to charging instructions in paragraphs 1.7 and 1.8 prior to charging the LANTech 100 units.

The system also includes a seven foot patch cable, a six foot patch cable, and a three foot patch cable for system interconnection. Correct connection of the patch cables is essential in order to obtain accurate test results (refer to the illustration following paragraph 1.3.3). The following is basic operating information for each of the major units and should be read before proceeding.

1.3.1 LT-100 Hand Held Cable Tester

The LT-100 is housed in a rugged, handheld ABS plastic case. Operating keys are in a sealed membrane keyboard on the face of the unit directly below the LCD viewing area.

Two connectors are located on the top of the unit:

RS-232 Port
A nine-pin, PC/AT compatible serial RS-232C output port for attachment to a serial printer or to a PC serial port.

Battery Charger Input Jack
A battery adapter input jack for recharging the internal batteries or for operating with the battery eliminator connected to an AC outlet.

Two connectors are located on the bottom of the unit:

RJ-45
An eight-line modular receptacle for twisted pair cable attachment.

BNC
For coaxial cable attachment. Twinax cable connections can be made with use of CA-TWIN adapter. Type N coax (Thicknet coax) connection can be made with the use of BNC-N adapters.

All circuits are initialized and internally checked when the instrument is turned on. Calculation constants such as NVP and high/low limits are set based on the Cable Type selected. Refer to Appendix A for preset limits.

1.3.2 AXT-110 Smart Terminator

The AXT-110 Smart Terminator is intended for use at the far end of a cable under test and should only be used with the three foot RJ-45 to DB25 Patch Cable. It provides appropriate pre-programmed termination for all Autotests, Quick Tests, and specific Diagnostic tests. When the Line Map is run, the AXT-110 will return an office identification of "A".
The unit is designed to operate normally for up to 5 hours on a single charge or to operate indefinitely while on the battery charger/ eliminator.

When turned on, the green LED status indicator located next to the On/Off switch will blink at different rates to indicate battery charge level and the test being executed per the following chart.

Idle State, Battery Good Indication
On - .25 seconds
Off - 1.25 seconds
Idle State, Battery Low Indication
On - .25 seconds
Off - 4.00 seconds
NEXT Test in Progress
On - .25 seconds
Off - .25 seconds
Attenuation Test in Progress
On - 1.25 seconds
Off - .25 seconds

NOTES: 1. *The Low Battery indication (6.9V) will only activate in the idle state.*
2. *Failure of the LED to light when the unit is turned on is an indication of a dead battery, automatic low battery shutdown (<6.6V) or possible unit problems. Try recharging the battery or operating the unit on the AC Charger/Eliminator to regain normal LED status indications before calling the service number.*

The red "charging" LED on both the AXT-110's and AXT-111's is to aid the user in knowing that charging power has been properly applied to the unit. This LED will only light when more than 9 VDC has been applied to the charging jack from one of the chargers supplied with your LANTech.

If you connect the charger unit to the AXT and an AC wall outlet and the red LED does not light, check each of the following possible causes to correct the problem:

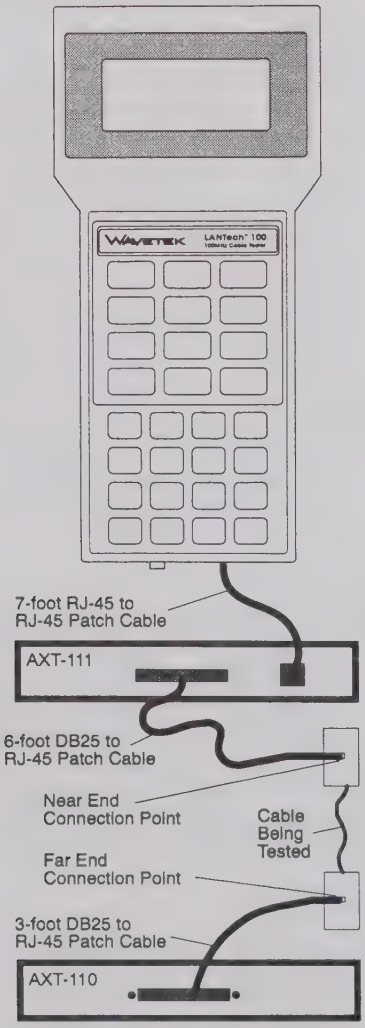
1. Wall outlet control switch turned off.
2. Tripped circuit breaker.
3. Defective wall outlet (i.e. loose contacts or wiring). Try another outlet to confirm the problem.
4. Disconnected/defective extension cord.
5. Extremely low line voltage combined with a fully charged battery can cause the LED to remain extinguished. This cause can only be detected by checking the output of the charger with a multimeter for more than 9 VDC and noting a good charge indication on the green LED with the charger not applied.
6. Defective charger/broken charger cord. Switch 9 VDC charger units to check for this.

NOTE: *When operating on the charger , some tests may cause the red LED to temporarily extinguish during the test. This indication is normal due to sudden power drains and is not an indication of a charging power disruption.*

1.3.3 AXT-111 NEXT Injector

The AXT-111 NEXT Injector is intended for use at the near end of the cable under test and should only be used with the six foot RJ-45 to DB25 Patch Cable connected to the system under test. The six foot RJ-45 to RJ-45 Patch cable should be used only for connection to the LT-100. It provides all appropriate pre-programmed sequences to perform NEXT testing during Autotest, Quick Test, and specific Diagnostic tests.

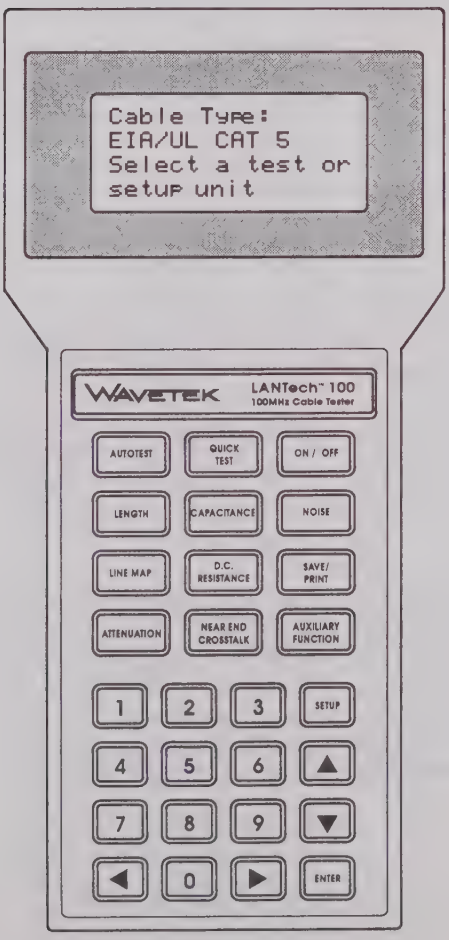
The unit is designed to operate normally for up to 5 hours on a single charge or to operate while on the battery charger/eliminator. One additional charging jack is installed to jumper charging power from the AXT-111 to the LT-100. Refer to charging configurations and CAUTION statements in paragraph 1.3.



The AXT-111 has green LED status and red LED Charging indicators which operate exactly the same as the indicators on the AXT-110.

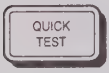
1.4 Keyboard Operation

The LT-100 keyboard is divided into three easy to recognize color coded areas. These areas are color coded for your convenience.

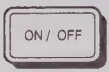


RED keys are multi-function. They perform more than one test or activity and with the exception of AutoTest, Quick Test and On/Off they present a menu to the user. Refer to each key's specific operating instruction paragraph for details on its use, testing configuration, and menu structure. The keys functions are as follows:

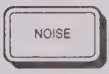
Begins an automatic sequence of cable tests dependent on the cable type selected. Runtime = 1 min. 30 seconds.



Begins an automatic sequence of cable tests dependant on cable type selected. NEXT tests use a reduced step measurement technique to provide rapid test results. Runtime = 45 seconds.

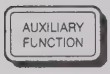


Turns the only the LT-100 Hand Held unit on and off.



Selects noise testing functions for either Transient (impulse) Noise or Average Noise.

Enables the user to save up to 150 test results in internal memory for future down-loading to a PC or printing, or to down-load or print immediately using the RS-232 serial port.



Selects other specialty tests including LAN Traffic monitoring, Propagation Rate testing, and LT-100 Self Test.

Selects system setup functions. Included are cable type selection, feet/meters units selection, save/ restore custom configurations, AXT-110/AXT-111 Calibration, time and date set, display contrast adjustment, BAUD output rate selection, and power-off delay adjustment.

BLUE keys are for individual Diagnostic testing. The test performed is identified on each key. With the exception of LINE MAP, which checks all pairs, all tests can be easily run on any selected pair using the up or down arrows to select different pairs. BLUE key descriptions are:

Performs continuous length tests on the selected cable pair. Propagation rate can be changed while the test is in progress by entering the value using the numeric keypad.

Performs continuous mutual capacitance measurement on the selected cable pair.

An end-to-end connectivity test of all eight conductors in the RJ-45. Reports status on opens, shorts, reversals, and miswires. This test will repeat only when re-started.

A continuous measurement of the loop resistance of the selected pair, or the coax/twinax cable conductor and shield.

Measures signal loss on the selected pair using a 500 kHz - 100 MHz swept square wave signal provided by the AXT-110 Smart Terminator. This test repeats only when restarted.

Measures the amount of induced noise at the near-end of the cable under test using the AXT-111 NEXT injector and AXT-110 Smart Terminator. This test repeats only when restarted.

GRAY keys are primarily for numeric data entry and menu selection. Except for the arrow keys, the gray keys have only single functions.

Performs pair selection in all individual updating tests (length, capacitance, average noise, attenuation, D.C. resistance, and transient noise). Used to select the TEST PAIR in the Near-End Crosstalk tests and Attenuation tests. Also used to select alphanumeric characters in the custom cable tagging and test saving operations. Hold down either arrow key to scroll more quickly.

Used to select the SOURCE PAIR in the Near-End Crosstalk test. Selects frequency band for Average Noise test, and is used to step right when entering alphanumeric characters.

Used as an ESCAPE key, this arrow takes the user one step back in a menu ora data entry position. It also serves to cancel/stop the selected test.

This key is used to execute a selected test or save/restore a custom tagged configuration.

Numeric Keys are used for menu item selection, numeric tagging of custom configurations and saved tests, and data entry values.

1.5 Auxiliary Functions

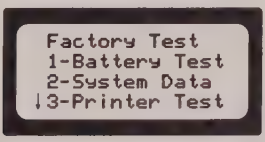
The Auxiliary Function Key's menu has a variet of user features:

1. LAN Traffic
2. Prop Rate
3. Factory Tests

Menu items 1 and 2 are discussed later in paragraph 4.8. Menu item 3, Factory Tests, has sub-menu important to review now in the introduction.

1.6 LANTech Factory Tests

Four testing modes are available for checking internal operation of the LANTech 100.



Battery Test and Printer Test are the only two Factory Tests intended for operator use. System Data is are intended only for factory testing purposes.

1.6.1 Battery Test (LT-100 Only)

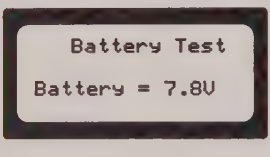
Used to check the internal battery voltage of the LT-100 Hand Held unit. The normal operating range is 6.9 to 8.5 volts. (Up to 12.0 volts with battery charger connected.)

NOTE: When the battery voltage drops below 6.9 volts, the unit will beep 3 times and the display will advise to connect the battery charger/eliminator.

NOTE: When the battery voltage drops below 6.5 volts, the unit will power down in order to preserve memory contents.

Procedure

1. Press AUXILIARY FUNCTION key.
2. Press 3 for FACTORY TESTS
3. Press 1 for BATTERY TEST.



4. Press the left arrow key to exit.

NOTE: Battery voltage for the AXT's is tested continuously and indicated by the green status lights. Refer to Section 1.3.2 for AXT low battery indications.

1.6.2 Printer Test

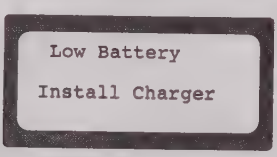
This test can be used to check proper connections between the LANTech 100 and a serial printer. The LANTech 100 will output a continuous stream of ASCII characters.

Procedure

1. Press AUXILIARY FUNCTION key.
2. Press the 3 key for FACTORY TESTS.
3. Press the 3 key for PRINTER TEST.
4. To stop the Printer Test, press the left arrow key. It may take a few seconds for the printer buffer to empty and for the printer to stop.

1.7 Battery Charger/Eliminator

The LT-100 will operate for 3 to 5 hours on a full recharge. The unit will automatically power down to preserve the battery power (Refer to paragraph 1.9.4 for setting power-off delay). When the battery voltage drops too low, the LT-100 will issue a triple beep and the following message will appear:



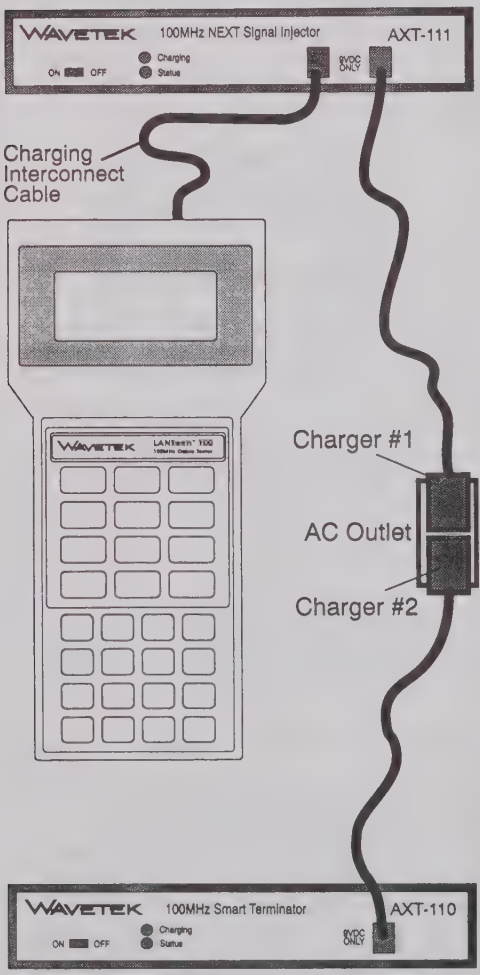
The LT100 can be charged directly from the charger or indirectly via the dual charging jacks on the AXT-111. Refer to the charging Configuration on the following pages. There is a charging interconnection cable designed for jumpering the 9 VDC line charger connected to the AXT-111 to the LT-100. This cable eliminates the need for a third AC charging unit and permits operating even if both units must be on an AC line charger at the same time.

If you wish to check the charging voltage on the LT-100, use the procedure in paragraph 1.6.1, Battery Test. You will note a 1 to 4 volt jump when the DC charging plug is inserted.

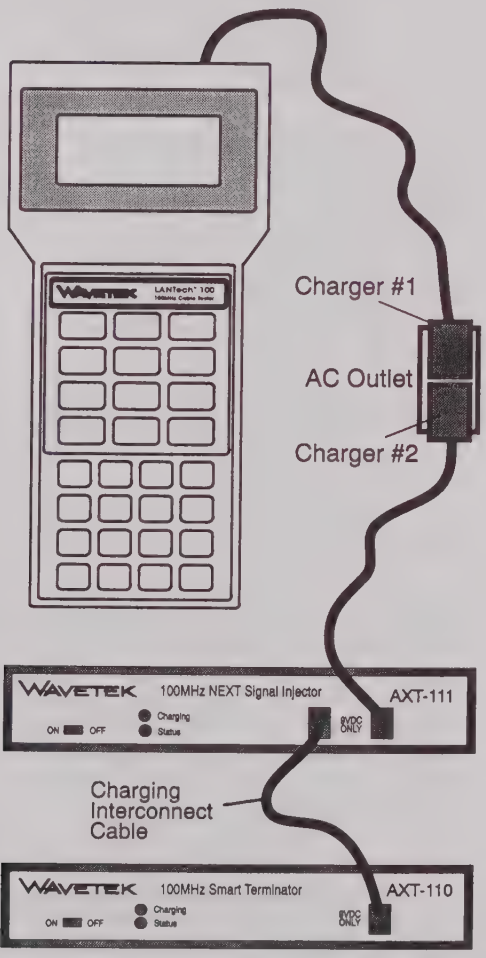
Charging Caution Information

All three units have a common charger input jack and can be charged or operated with the AC charger directly. The AXT-111 unit has an additional output jack designed exclusively for jumpering charging power from the AXT-111 input to the LT-100 or AXT-110 units. This interconnect charging cable can only be used when the AXT-111 is connected to an AC charger. The following figures are the only acceptable charging or operating configurations.

Charging Confuration #1



Charging Confiuration #2



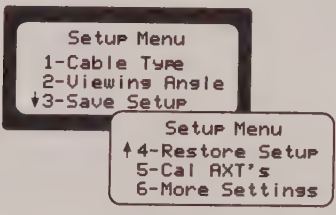
WARNING: *Do NOT attempt to operate either the LT-100 or the AXT-110 using the charger interconnect cable without an AC charger connected. This action will overload the Nicad battery pack in the AXT-111, damage the unit, and void the warranty.*

1.8 Charging Recommendations

- Charging time ranges from 8 to 10 hours to obtain a full charge.
- Allow batteries to discharge until a low battery indication is displayed before recharging. This will prevent the NiCads from developing a low capacity memory that will reduce the normal operating time.
- Check for a red LED Charging indicator on the AXT's and use the Battery Test (refer to paragraph 1.6) on the LT100 to ensure that charging voltage is applied.
- Units charge more rapidly when turned off during charging.
- The chargers supplied with your LANTech 100 use a connector with a center negative and a positive shell charging polarity. Be sure that replacement chargers use the same size and polarity of connectors, voltage, and current capacity as those supplied with the LANTech 100. Replacements are available directly from Wavetek or through your local distributor.

1.9 Setup

The SETUP key is used for a variety of tasks involved with instrument setup and pretesting options. The menu shown below is in the order of most used to least used features. However, each feature is addressed in the section of the manual where it best applies.



The first four features covered are one-time instrument setup options in the sub-menu "More Settings".

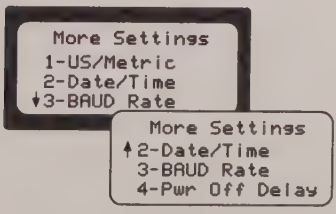
1.9.1 Setting Feet/Meter Units

This establishes the unit of measure for length measurements.

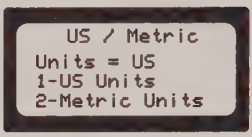
Procedure

1. Press the SETUP key. The Setup Menu will appear.

2. Press 6 for More Settings:



3. Press 1 for US/Metric:



4. Select 1 for US units (feet) or 2 for metric units (meters).

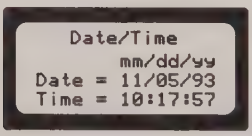
5. Proceed with other Setup operations in the More Settings Menu (refer to paragraphs 1.9.2 thru 1.9.4), or press the left arrow ◄ once to return to the Setup Menu, or twice to return to the Main Menu.

1.9.2 Setting Date/Time

This setting defines the current date and time for recording with all test results.

Procedure

1. Press the SETUP key.
2. Press 6 for More Settings.
3. Press 2 for Date/Time.



4. The user can select the sequence of the month, day, year in the Date. For example:

US	mm/dd/yy
Europe	dd/mm/yy

Use the ▲▼ keys to change to the desired sequence.

5. Use the left ◄ and right ► arrows to move to different digits in a single Date or Time field, or to skip changing that field. Note cursor position for digit entry position.

6. Enter the first two date digits and press ENTER to move to the next two date digits. Continue until all date digits are correct. Pressing ENTER at the last date field will jump the cursor to the first Time field.

7. Enter the hour digits and press ENTER to move to the minutes digits. Press ENTER to move the cursor to the seconds digits and press enter again at the exact time to store the new Date and Time.

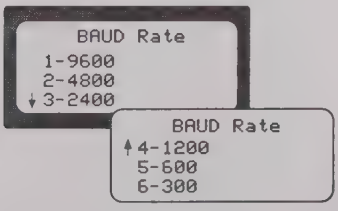
8. If you wish to skip changing a field's digits, use the right arrow to move to the next field.

1.9.3 Setting Output BAUD Rate

This setting defines the BAUD Rate for transmitting stored test results via the RS-232C serial output to a printer. The default BAUD rate is 9600.

Procedure

1. Press the SETUP key.
2. Press 6 for More Settings.
3. Press 3 for BAUD Rate.



4. Press the number next to the desired BAUD rate (1-6) in the menu. The program will exit the menus or selection or you can use the left arrow to exit without change.

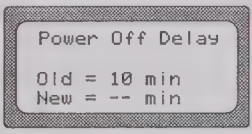
NOTE: If printed output is garbled or incorrect characters are being printed, verify baud rate settings on both the printer and the LANTech. Refer to the printer test in paragraph 1.6.2.

1.9.4 Setting Power-off Delay

The LT-100 automatically shuts off after a set time interval of inactivity in order to preserve battery power. The Power-Off Delay range is 3-99 minutes. The following procedure allows the user to set this time interval.

Procedure

1. Press the SETUP key.
2. Press 6 for More Settings.
3. Press 4 for Power Off Delay.



4. Enter new time delay value with the numeric keyboard.
5. Press ENTER to store the new value.

NOTE: If the wrong time delay value is entered, use the left arrow key to clear the displayed values and exit to the More Settings Menu. Press the 4 key again and re-enter the correct number.

1.9.5 Adjusting Display Viewing Angle

This setting adjusts the contrast of the display.

Procedure

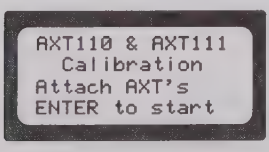
1. Press the SETUP key.
2. Press 2 for VIEWING ANGLE.
3. Press the UP or DOWN Arrow to adjust the display for the optimum contrast.
2. Press the left arrow ◄ key to exit.

1.9.6 Calibrating AXT-110 and AXT-111

It is recommended that the AXT-110 Smart Terminator and AXT-111 NEXT Injector be calibrated before attenuation and NEXT tests are run in order to compensate for battery voltage. It is only necessary to calibrate once per day prior to use, or if the charger(s) are connected to either unit during use.

Procedure

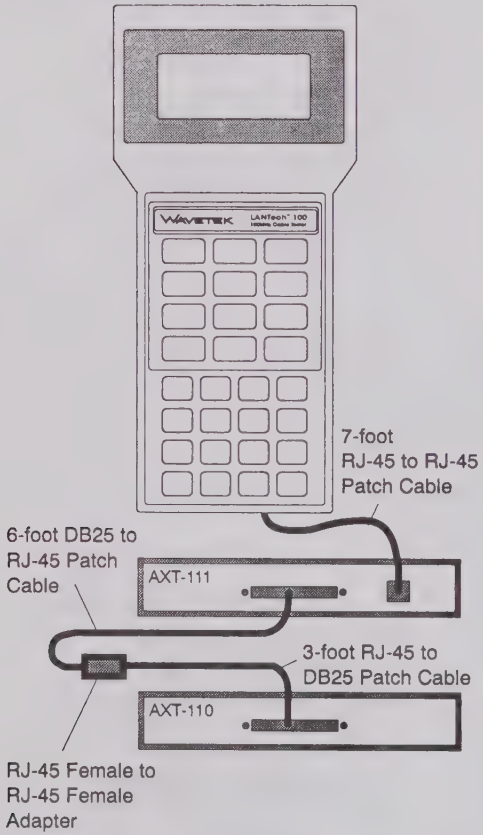
1. Select one of the twisted pair cable types. (Refer to the procedures in Section 2.)
2. Press the SETUP key, then the 5 key for "AXT-110 & AXT-111 Calibration." The following display should appear.



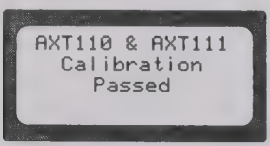
3. Power on and attach the AXT-110 Smart Terminator with the AXT-111 Next Injector as shown:

NOTE: The RJ-45 Female to RJ-45 Female Adapter is intended only for calibration use. This adapter is not UL Level 5 rated and will cause NEXT test failure if used during testing.

Calibration Confiuration



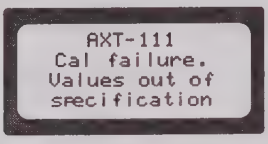
4. Press ENTER to start calibration and wait for a passed/fail indication:

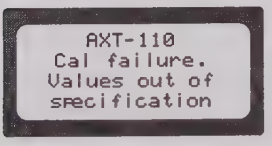


5. Press the SETUP key to exit the calibration procedures.

Error Messages:

Should either of these error messages appear, perform the following procedures to correct the problem and rerun the calibration procedures starting at Step 1.





Calibration Failure course of action:

1. *Verify proper connections between all devices using known good patch cables.*
2. *Verify all devices are powered on.*
3. *Check one or both AXT's for low battery indications, connect the chargers to low units and re-calibrate.*

Selecting Cable Type

Upon "power-on", the LT-100 will return automatically to the last cable type selected before power was turned off.

The user can select from 20 pre-programmed standard cable types. You can also customize and store up to 9 different cable configurations.

2.1 Standard Cable Selection Procedure

1. Press SETUP key.

2. Select menu item 1 for CABLE TYPE.

3. Standard cable types are grouped in the following categories:

   Ethernet
   Token Ring
   Twisted Pair
   Miscellaneous

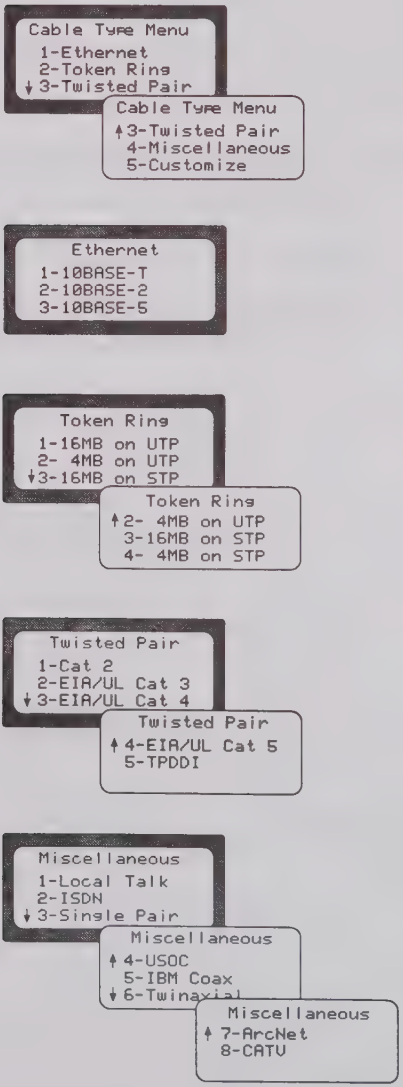
   Refer to Figure 2.1 and Appendix A for complete list of Standard Cable Types.

4. Use the numeric key pad to select the appropriate cable group first, then the desired cable type within that group.

5. To return to the main menu, press left ◄ arrow key. You may also go directly to any test function.

Refer to Appendix A for the pre-programmed default test limits for each of the standard cable types.

Figure 2.1 Pre-Programmed Standard Cable Types

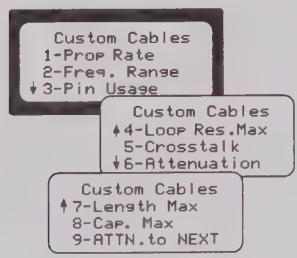


2.2 Cable Customization Procedure

The LT-100 provides the user with the capability of defining all test limit parameters and saving those as a custom configuration. Access as follows:

NOTE: To simplify cable customization, it is recommended that you first select a similar cable type from the Standard Cable Types memory. Then you need only make necessary changes using the following procedure:

1. Press the SETUP key.
2. Press 1 for Cable Type.
3. Press 5 for Customize.



Test Limits may then be customized using the following keys:

UP & DOWN Arrows
When shown as usable on the LCD they will cycle through selectable items, i.e., when customizing **Pin Usage**, the UP & DOWN arrows alternate between the BNC and RJ45 ports.

LEFT Arrow
Moves one space left to edit a previously chosen character or exit if the cursor is at the left-most position.

RIGHT Arrow
Moves the cursor to the right to select a new digit position to change.

0-9 Keys
Used to change the default value at the cursor position indicated on the LCD. When in "Pin Usage" menu the 0 key will disable that pin assignment.

ENTER
Exits current limit assignment mode using new configuration.

NOTE: *If you wish to exit without saving your changes, use the LEFT arrow key as many times as necessary to exit back to the "Custom Cables" menu.*

There are five user-selectable methods for performing cable testing/certification available in the LANTech 100. It is important to understand these methods prior to performing any measurements.

ACR - The ACR method allows that while a Crosstalk reading may numerically exceed EIA/TIA's Model crosstalk recommendations, it may not be detrimental to link performance. If a NEXT reading is over limits by less than 4 dB, but the ACR is satisfactory for that same pair, an "All Tests Pass" indication will be given. An asterisk will appear on the test results printout to indicate where a crosstalk reading exceeded the limit. Note that the ACR method of certification/testing is the default method used by the LANTech 100 for testing Category 5 cables only.

EIA MODEL - This method is based on the EIA/TIA Network Model of "recommended" Near-End-Crosstalk (NEXT) limits for measurements taken from the cable closet to the work station wall outlet.

The EIA/TIA specifies the performance standards for network cable and cable plant components, but at the time of publication there is no EIA/TIA standards for network links or channels.

However, the EIA/TIA has drafted recommendations for performance standards for network links, and Wavetek bases its EIA Model method for EIA/TIA 568 Categories 3, 4 and 5 on this preliminary document.

The EIA Model method compares the measured test results against the EIA Model limits across the entire frequency spectrum selected by the user. The EIA Model method of certification/testing is the default method used by the LANTech 100 for testing Category 3 and 4 cables.

FLAT - This method is user selectable for all cable types stored in the LANTech 100. The Flat method uses a constant NEXT limit for measurements across the selected frequency spectrum.

The limit value is based on the EIA/TIA recommended NEXT for the highest of the selected band (e.g. EIA/TIA Cat 4 = 20 MHz, EIA/TIA Cat. 5 = 100 MHz).

This method may not indicate a low frequency NEXT out of limit condition as defined by the EIA Model method. Flat method is best employed when certifying/testing network cable plant that will be used for a known specific frequency (e.g. 16-Mbit Token Ring).

SKIP - This method skips Attenuation or NEXT tests in the Autotest sequence, and is used only for coax autotest and specialized troubleshooting.

IGNORE - This method executes the Attenuation or NEXT tests, but does not compare the results to the limit and is used to obtain specific testing data without regard to Pass/Fail criteria.

When setting cable parameters for **5-Crosstalk** or **6-Attenuation**, use the UP or DOWN arrows to view and select one of the available test methods listed above.

The following is a list of the different parameter limits in the order in which they appear in the "Custom Cables" Menu. Refer to Appendix A for the complete list of cable types and their default limits.

#1 Prop. Rate
Nominal Velocity of Propagation (NVP).

#2 Freq. Range
The range of frequency used for Attenuation and NEXT testing.

#3 Pin Usage
Pin/pair assignments.

#4 Loop Res. Max
Loop Resistance maximum limit.

#5 Crosstalk
Crosstalk (NEXT) limit in dB up to maximum frequency.

#6 Attenuation
Maximum loss acceptable for cable type.

#7 Length
Length, maximum specified for network segment.

#8 Cap. Max
Maximum acceptable mutual capacitance in pF/ft.

#9 ATTEN to NEXT
ACR Ratio (difference) between the greatest measured attenuation and greatest measured NEXT, expressed in dB.

2.3 Saving Custom Cable Configurations

Once the limits have been assigned for a custom cable configuration, it may be saved for later use.

Preliminary

After using the procedures in paragraph 2.2 to customize a cable type, remain in the Custom Cable Menu.

Procedure

1. Press the SETUP key.
2. Press 3 for SAVE SETUP.
3. Choose an address (1 – 9) to save the current configuration to. If the address shows as "unused" it is available. If any other name is in the address, a custom cable is being specified and choosing that address will delete the existing custom cable and replace it with the new cable type.
4. Enter a TAG (Name) for your custom configuration using the following keys. Maximum length is 13 characters.

UP/DOWN Arrows
Scroll through the all available alpha-numeric characters. Hold down either arrow to scroll more quickly.

LEFT Arrow
Move one space left to edit a previously chosen character or exit if at the extreme left side of the Tag name.

RIGHT Arrow
Move one space right leaving the chosen character in the previous space.

0 – 9 Keys
Used for direct numeric tag entry.

ENTER
Stores the chosen tag and custom cable configuration.

2.4 Restoring Custom Configurations

Restore is used to recall a customized cable for testing purposes or to change one or more parameters

Procedure

1. Press the SETUP key.
2. Press 4 for RESTORE SETUP.
3. Choose the number corresponding to the configuration you desire to use for testing or change.

The LCD will display the chosen tag for 2 seconds to confirm your choice, then return to the Setup Menu.

If you want to proceed with testing, press the left arrow key once to return to the Main Menu.

If you want to change the cable's parameters, press, press 1 - Cable Type, then 5 - Customize and follow procedures in paragraphs 2.2 and 2.3.

Autotest & Quick Test Operations

Both Autotest and Quick Test operate in a similar manner in that they both run the same following tests:

- Line Map (shield continuity if applicable)
- Loop Resistance
- Near-end Crosstalk
- Attenuation
- Length
- Mutual Capacitance

The difference is in a technical approach to performing the NEXT test. The Autotest will perform NEXT by sampling from 100 kHz to 100 MHz using 100 points per decade in logarithmic increments for a total of 300 samples. Quick Test performs NEXT by sampling from 1 MHz to 100 MHz using less than 100 logarithmically incremental steps.

The Quick Test method reduces test time, but may not be usable for all certification requirements. Prior to performing a cable certification be sure to check all specifications for which method is acceptable.

Setups and procedures in this section apply to both Autotest and to Quick Test.

3.1 Twisted Pair Cable

The following tests are performed in Autotest and Quick Test:

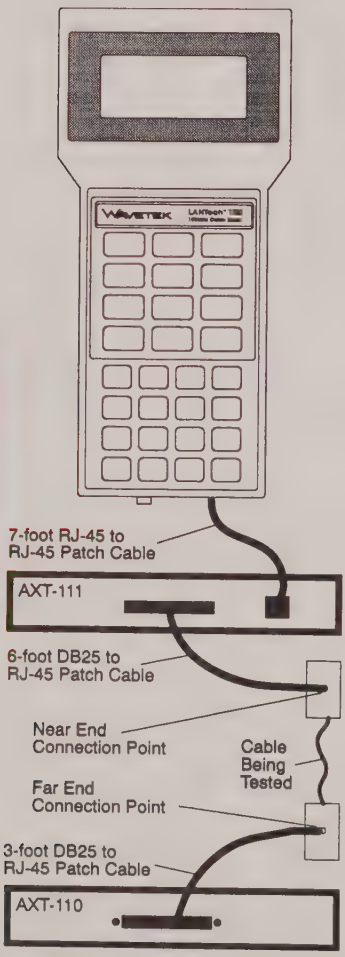
Line Map (and Shield if Applicable)
Loop Resistance
Near-End Crosstalk (NEXT)
Attenuation
Length
Mutual Capacitance per foot (meter)

Procedure

1. Attach LT-100 to cable-under-test according to the following diagram:

NOTE: It is recommended that the AXT-110 and AXT-111 be calibrated once each day, or if the battery charger is added or removed during testing, in order to maintain the best accuracy. Refer to paragraphs 1.7 and 1.8.

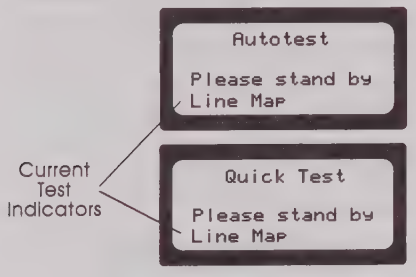
System Testing Configuration



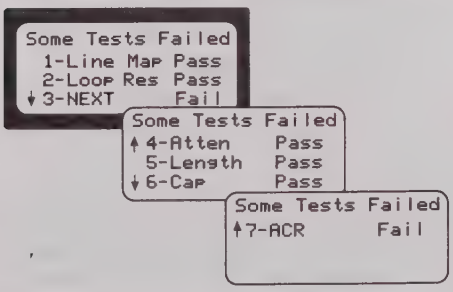
NOTE: This testing configuration is used for:
Autotest
Quick Test
Diagnostic Attenuation and Crosstalk.
Refer to Section 4, Diagnostic Mode Testing for a full matrix of testing configurations.

2. Select the cable type (Refer to Section 2).

3. Press Autotest or Quick Test and the display will present one of the following screens:



4. Upon Autotest or Quick Test completion, test summaries will appear in the display as either pass/fail.
   A double beep signal in the LT-100 Hand Set and AXT-110 Signal Injector notifies the user when either test is complete.



NOTE: *If less than four (4) pairs are selected for testing, the test times will be reduced accordingly.*

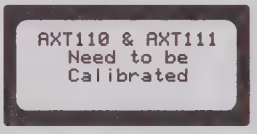
NOTE: *If **Ignore** is selected for either the Attenuation or NEXT test, no pass/fail criteria will appear for that test nor will ACR.*

NOTE: *If you select a single pair to test, no NEXT test will be run, and no ACR calculation is performed.*

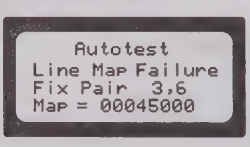
Use up/down arrows ▲▼ to scroll through summary of test results. The results for any test can be examined in detail by selecting the number corresponding to that test result in the display. Refer to Section 4 Diagnostic Mode Testing for help in interpreting test results.

5. After reviewing the test results, you may save the results, print the results, download results to a PC, or set up for another test. Refer to Section 5.

Error Messages



Calibrate the AXT-110 and AXT-111 as indicated in paragraph 1.9.6.



Autotest or Quick Test will abort if it does not find the first pin usage pair properly connected during Line Map. Normally this will be the 1,2 pair, but if a cable type is selected or customized for only 3,6 and 4,5 pin/pair usage, then an abort will occur if 3,6 pair is not properly connected.

If this occurs, recheck cable connections and make sure AXT-110 and AXT-111 units are powered on (look for lighted LED on end-panels). If Autotest or Quick Test still aborts, correct cable problem using displayed map codes. Refer to paragraph 4.4 for code interpretation.

Default Test Limits

Refer to Appendix A for the pre-programmed default test limits for each of the standard cable types.

3.2 Coax Cable Autotest or Quick Test

There are two (2) methods of performing Autotest or Quick Test on coaxial cables. They are:

Flat - This method permits using the AXT-111 and AXT-110 connected to the cable using two accessory CX-ATN's and will perform all of the following tests:
DC Resistance, Attenuation, Length, and Capacitance

Skip - This method uses a shorted and open termination on the cable to perform the following tests:
DC Resistance, Length, and Capacitance

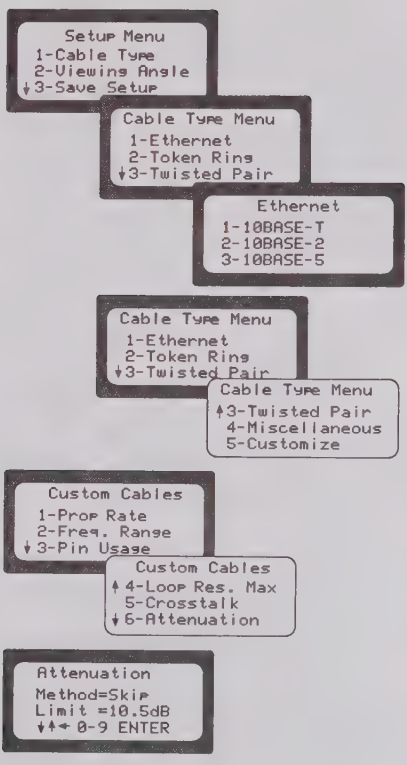
Refer to the different test configurations in paragraphs 3.21 for Flat method and 3.22 for Skip method

Preliminary

A. To select the desired coax Autotest or Quicktest method, press **SETUP**, **1-Cable Type**, and then select either **1-Ethernet** for 10BASE2 or 10BASE5, or **4-Miscellaneous** for other coax types (refer to Appendix A for a list of all programmed cable types).

B. Once the cable type is selected, you will exit back one menu to the **Cable Type Menu**. Press **5-Customize**, then **6-Attenuation**. The first item under Attenuation is **Method=Skip.**

C. The **Up/Down** arrows permit changing the method to Flat, or Ignore. Select the desired method of testing, make any limit alteration desired, and press Enter to lock-in the values and exit the menu.



D. To save this setup as one of the nine custom cables, press the left arrow key twice to go back to the Setup Menu, select **3-Save Setup**. Refer to paragraph 2.3, Saving Custom Cable Configurations for detailed instructions.

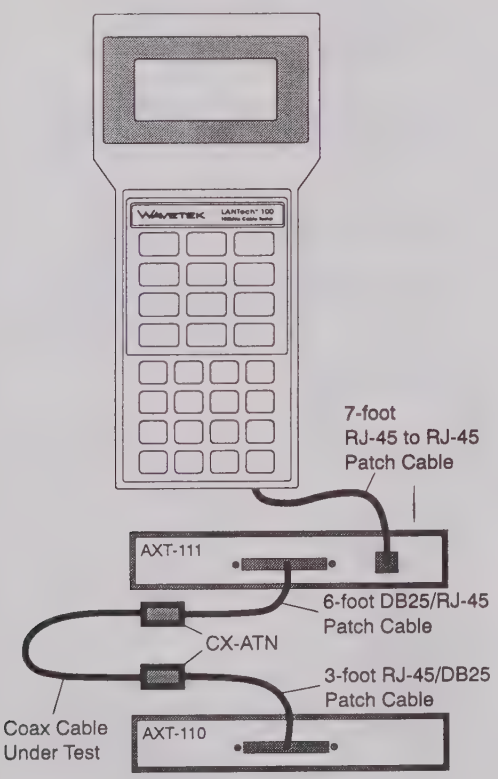
or

E. To exit back to the main menu, press the left arrow key three times. The main menu will reflect the cable type selected.

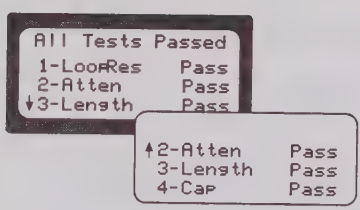
Procedure

3.21 Method=Flat

1. Attach LT-100, AXT-111, and AXT-110 to the cable under test according to the following diagram:



2. Press **Autotest** or **Quick Test**, then **ENTER**
3. Upon completion, test summaries will appear in the display as pass/fail.

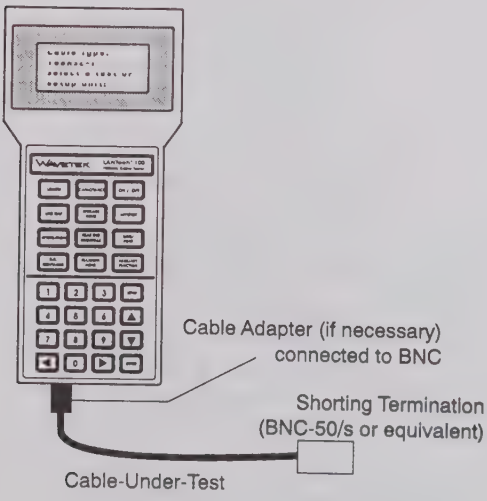


4. To examine the test results in detail, select the number corresponding to that test result in the display.

5. Test results may be saved, printed, or downloaded to a PC. See Section 5 for detailed procedures.

3.22 Method = Skip

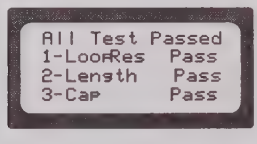
1. Attach LT-100 to the cable under test according to the following diagram:



2. Press **Autotest** or **Quick Test**, ensure that the cable is terminated in a short, then **ENTER**

3. Follow the directions in the display as to when to remove the shorting termination, and press **ENTER** again.

4. Upon Autotest completion, test summaries will appear in the display as pass/fail.



5. To examine test results in detail, select the number corresponding to that test result in the display.

6. Test results may be saved, printed, or downloaded to a PC. See Section 5 for detailed procedures.

Error Messages Refer to Section 4 Diagnostic Mode Testing for interpretation of test results and error messages.

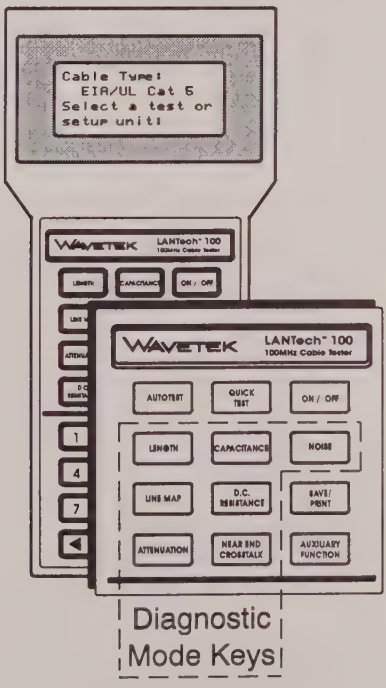
LANTech 100 TESTING CONFIGURATION GUIDE (Part 1)			
Test Type	**AXT-111 (Near End)**	**AXT-110 (Far End)**	**Notes**
Autotest	YES	YES	Line Map, DC Resistance, NEXT, Attenuation, Length, Cap, and SNR.
Quick Test	YES	YES	Line Map, DC Resistance, NEXT, Attenuation, Length, Cap, and SNR.
Autotest-Coax (Skip) (Flat)	NO YES	NO, Short then Open YES	Connect directly to LT-100 and follow the display instructions. For Attenuation reading, use AXT's and connect with 2 CX-ATN's
Length	NO	NO, Open then Short	Connect cable directly to LT-100 or use patch cable to connect to installed network link via jack.
Line Map (UTP) (STP)	Optional on UTP YES	YES or IT-2 YES	Includes Office ID: AXT-100 = A, IT-2 = 1 through 8 as selected. Shielded Twisted Pair (STP) requires both AXT's
Capacitance	NO	NO, Open	Capacitance results must be divided by the length to obtain pF/ft (meter).
Attenuation	YES	YES	For coax connections, use 2 CX-ATN's and short lengths of patch cables.

LANTech 100 TESTING CONFIGURATION GUIDE (Part 2)			
Test Type	**AXT-111 (Near End)**	**AXT-110 (Far End)**	**Notes**
NEXT	YES	YES	Make sure that the selected source and the test pairs are not the same.
DC Resistance	NO	NO, IT-2 or short measured pair	With IT-2, use pair 3,6 and subtract the 100 Ohms termination resistance. With the pair shorted, read the loop resistance directly.
Noise Transient (impulse) Average	NO	Optional. For best results use 100 Ohm termination resistor.	Connect directly to LT-100 and terminate test pair with 100 Ohm resistor or check for a non-operational network link.
Propogation Rate (NVP calculation)	NO	NO, Open or Shorted	Connect cable directly to LT-100 or use patch cable to connect to network link.
Traffic Monitoring	NO	NO, Network	Connect to active Ethernet. For monitoring on inactive side of hubs, use CA-8MP-DUAL to parallel LT-100 with active work station.

Refer to specific testing guidance section for details on setup and testing.

Diagnostic Mode Testing

Occasionally you may need to perform only a single test such as Length or Line Map in order to diagnose a particular problem. Diagnostic Mode tests are designated by the BLUE keys and one RED noise key on the keypad (refer to the diagram below). This section will identify the procedures for each of the tests available and illustrate the cable connections and proper termination for each test.



Diagnostic Mode tests require appropriate cable terminations to work correctly. While the AXT-110 and AXT-111 are used in Autotest and Quick Test, the Diagnostic Mode often requires different terminations to obtain accurate results. These terminations are outlined in the matrix at the front of this section and are defined as follows:

Short

Two wires of a twisted pair, or center conductor and shield of a coax cable, connected together at the far end of the cable under test. This termination adds the least possible D.C. resistance to the overall circuit. Used for D.C. Loop Resistance and can also be used for Length.

Open

Two wires of a twisted pair, or center conductor and shield of a coax cable, disconnected at the far end of the cable under test. This termination adds infinite resistance to the circuit. Used for Length and Capacitance measurements.

Match

A resistive termination with the same value in D.C. Ohms as the characteristic impedance of the cable under test.

For example, a 100 ohm (characteristic impedance) twisted pair cable would be matched with a 100 ohm resistor across the tested pair.

This is the termination found on a normally operating live network circuit. Used for Average Noise, Transient Noise, and Near-End Crosstalk tests.

NOTE: Do not attempt to measure length on a cable segment with a matched termination. An incorrect measurement will result.

Smart Terminator AXT-110
An automated device containing the required twisted pair line terminations for Attenuation, NEXT and Line Map diagnostic tests.

NEXT Injector AXT-111
An automated device containing the required twisted pair near-end line terminations for the NEXT Diagnostic Mode testing.

At the end of each test, you may save the results, output to a printer or down-load to a PC. Refer to Section 5 for instructions.

4.1 Length Test

Cable Types Tested
Twisted pair or coax/twinax

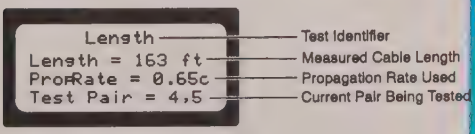
Range
18 - 2000 ft (5.5 - 610 meters) Twisted Pair
18 - 3000 ft (5.5 - 915 meters) Coax

Termination
OPEN or SHORT

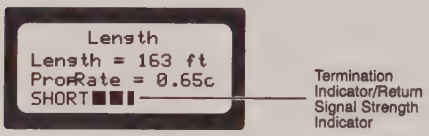
Procedure

1. Select the correct cable type and connect the cable directly to the LT-100 hand held unit.
2. Terminate the cable with either an Open or a Short.
3. Press the blue LENGTH key.
4. Set the Propagation Rate by directly entering the desired value using the numeric keypad. The propagation rate can be changed even while the test is in process. Press ENTER after the correct propagation rate has been entered.

   If the cable propagation rate is unknown, determine its value by following the procedure in paragraph 4.8.2.
5. Select the test pair using the up/down arrows ▲▼. This can be done even after the Short/Open indicator and signal strength bar appears.



After a few seconds, the display will change to this:

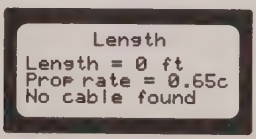


NOTE: The Length test in Diagnostic mode continuously updates once initiated until another test is selected. If the Length test is giving incorrect length readings, a possible cause is an improper termination or the propagation rate is incorrect.

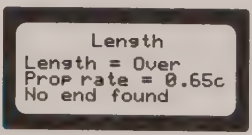
Return Strength Indicator

The return signal strength indicator will be proportional to the amount of transmitted signal that is reflected from the far end. A low loss cable will return a larger portion of the signal and display a longer bar graph than a high loss cable.

Error Messages



LANTech is unable to "see" cables that are shorter than the "dead zone." The dead zone is the first 18 ft or 5.5 meters of cable starting at the hand-held unit.



No signal reflection is detected. Make sure the cable is <u>not</u> connected to a matched terminator.

4.2 Capacitance Test

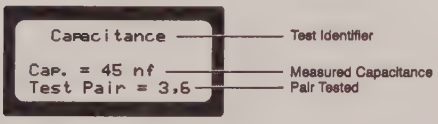
Cable Types Tested
Twisted pair and coax

Range
0 pf - 100 nf

Termination
OPEN

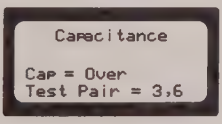
Procedure

1. Select correct cable type and connect the near end directly to the LT-100.
2. Terminate test cable with an OPEN.
3. Press the CAPACITANCE key.



4. Select another test pair using the Up/ Down arrows ▲▼.

Error Messages



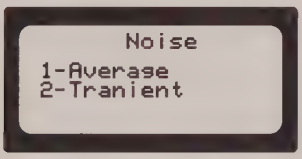
Measured mutual capacitance is over 100 nf Make certain the cable is **OPEN** at the far end. Any other type of termination (including High Resistance) will also cause an error message.

NOTE: In the Diagnostic mode, the Mutual Capacitance test measures total cable capacitance, and not capacitance per foot (meter) as in the Autotest mode. The capacitance test continuously updates once initiated until another test is selected.

NOTE: To calculate the test cable's capacitance per foot (or meter), first measure the length, then the capacitance. Divide the measured capacitance by the length.

4.3 Noise

The RED Noise key will call a primary selection menu as shown below.



Average noise will test for Electromagnetic Interference (EMI) in three bands and report both the band in which it was detected and the amplitude of induced voltage to a maximum of 2.5 volts. This makes it helpful to locate the source of the EMI and to note when the problem is corrected.

Transient noise will report by count the number of times a transient voltage spike exceeds the threshold voltage. The default threshold is 260 millivolts, but this can be user set from 1 to 2000 millivolts for monitoring.

Both tests are continuous reporting and transient noise will provide a time stamped printout for long term monitoring. Refer to Appendix B, figures E and G, for sample printouts.

Typical Noise Sources

Frequency	Possible Source
40 Hz – 150 kHz	AC Line, audio detect, some radio, switch mode power supplies, light dimmers, motors.
40 Hz – 20 MHz	Motors, medical equipment, induced network traffic.
20 Hz – 100 MHz	Radio, TV, microwave.

4.3.1 Average Noise Test

Cable Types Tested
Twisted pair or coax/twinax.

Range
40 Hz to 100 MHz.

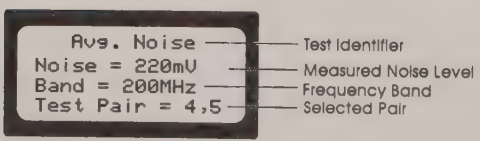
Termination
MATCH

Procedure

1. Select correct cable type and connect the cable directly to the LT-100 hand held tester.
2. Terminate cable with **matched** terminator.
3. Press the red NOISE key and then 1-AVERAGE .
4. Changing the test pair is done with the UP or DOWN Arrow keys.
5. Select the frequency band to monitor with the RIGHT Arrow.

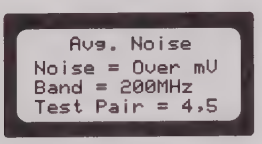
Frequency Bands:

150 kHz
20 MHz
100 MHz.



NOTE: The Average Noise Diagnostic Test continuously updates once initiated until another test is selected.

Error Messages



"Over" indicates that the measured noise in this frequency band exceeds 2.5 volts.

4.3.2 Transient (Impulse) Noise Test

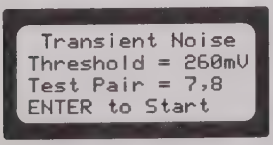
Cable Types Tested
Twisted pair or coax/twinax.

Range
0 to 2.0V (2000 mV)
Default Threshold = 260 mV

Termination
MATCH

Procedure

1. Select correct cable type and connect the cable directly to the LT-100 hand held tester.
2. Terminate cable under test with matched termination.
3. Press the red NOISE key and then 2-TRANSIENT .



4. Select the Test Pair using the up/down arrows ▲▼.

5. To select a different threshold voltage for transient detection, enter the new value with the keyboard. Use left arrow to delete errors made. Press ENTER to set a new value.

6. Begin the test by pressing ENTER.

7. Measured impulses will be displayed as Counts. The maximum number of counts that can be counted is 9999. After 9999, the count will return to zero and resume counting.

8. If you want a record of transient events, engage Print Text operation (refer to Section 5.3) after Step 6 above. The unit will record the time of each transient event up to one record per second.

   If bursts of transients are detected, the printer will record the number detected in one second intervals. Refer to Appendix B, figure G, for an example printout.

9. To stop this test, press left arrow ◄ or another function key.

4.4 Line Map Test

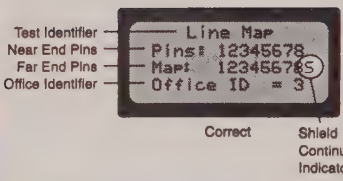
Cable Types Tested
Twisted pair up to 8 wires.

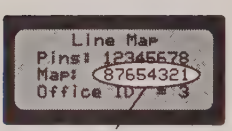
Termination
AXT-110 Smart Terminator™ or IT-2 Intelligent Terminator™.

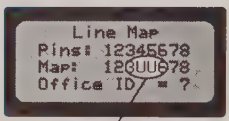
Procedure

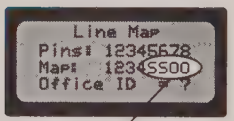
1. Select correct cable type and connect the cable directly to the LT-100 hand held unit.
2. Terminate test cable as described above.
3. Press the LINE MAP key.
4. All eight conductors and the shield (if installed) are tested, and the status of each line is displayed on the LCD. Office ID will show as "A" when the AXT-110 Smart Terminator is used, and display a number 1-8 when the multi-office Intelligent Terminators (IT-2) are used.

NOTE: Testing of shielded cable systems requires the use of CA-STP-100 shielded patch cables and both the AXT-111 NEXT Injector and AXT-110 Smart Terminator connected the same as in Autotest. This test requires that a minimum of three wires be connected to operate correctly. A good shield is indicated by an "s" to the right of line 8's position in the MAP line. A shield with broken continuity is indicated by the lack of an "s" in this position.









Error Messages

Office ID = ?
To obtain an office ID, RJ-45 lines 3, 5, and 6 must be connected.

Pin Designated by "O"
Indicates an open (not connected) line.

Pin Designated by "S"
Indicates a short circuit in the cable segment.

Pin Designated by "U"
Indicates a near-end short (no far-end terminator).

Pin Designated by "?"
Indicates far-end detected but of unknown value.

Pin designated by another number
Indicates a miswire.

Shield Continuity is indicated by an "s" to the right of line map position 8. The lack of this indication means a broken shield.

4.5 D.C. Loop Resistance Test

Cable Types Tested
Twisted pair or coax/twinax.

Range
0 – 50 kΩ

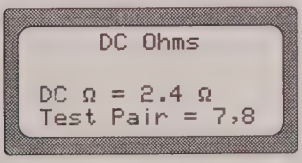
Termination
SHORT

Procedure

1. Select correct cable type and connect the cable directly to the LT-100 hand held unit.
2. Terminate cable under test with a SHORT.

NOTE: Loop resistance can also be determined with other resistive terminators (matched, IT-2 Intelligent Terminators, AXT-110), but the display result will be the SUM of the loop resistance and the terminating resistance.

3. Press the D.C. RESISTANCE key.



4. Select the Test Pair using the up/down arrows ▲▼.

Error Messages

DC Ω = Over
Measured resistance is greater than 50 kΩ. Check termination. Run the Length Test to verify condition of the desired test pair.

4.6 Attenuation Test

Cable Types Tested
Twisted pair or coax.

Range
500 kHz - 100 MHz

Dynamic Range
0 dB - 50 dB

Termination
Twisted pair - AXT-110 Smart Terminator and AXT-111 NEXT Injector.
Coax - (2) CX-ATN adapters, 6-foot (RJ-45 to DB25) patch cable, AXT-110, and AXT-111.

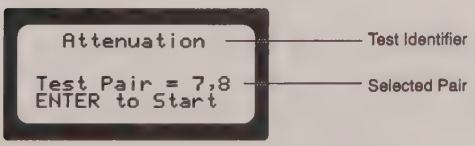
Procedure

1. Calibrate the AXT-110 Smart Terminator and AXT-111 NEXT Injector if necessary. Refer to the Calibration Procedures in paragraph 1.10.

2. Select correct cable type.

3. Connect the cable under test in the same manner as in Autotest:
   Twisted Pair - Refer to paragraph 3.1
   Coax - Refer to paragraph 3.2.

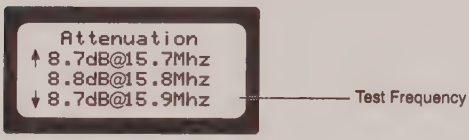
4. Press the blue ATTENUATION key.



NOTE: Selected pair will read BNC for coax.

5. For twisted pair, select the test pair with the up/down arrows ▲▼.

6. Begin the test by pressing the ENTER key.



7. At test completion, the worst case value will display on the screen. All other values and frequencies may be viewed by scrolling with the up/down arrows ▲▼. Hold down either arrow key to scroll more quickly.

8. To obtain a graph printout of attenuation over frequency, you must output to a printer or PC before running another test.

   Graphic results cannot be stored in LANTech's memory. Refer to Section 5 for Save/Print instructions.

4.7 Near-End Crosstalk (NEXT) Testing

Cable Types Tested
Twisted pair

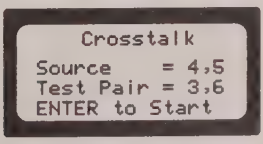
Range
100 kHz – 100 MHz

Dynamic Range
10 dB - 60 dB

Termination
AXT-110 Smart Terminator and AXT-111 NEXT Injector.

Procedure

1. Select correct cable type.
2. Calibrate AXT-110 and AXT-111 if necessary. Refer to Section 1.9.6.
3. Terminate cable under test in the same manner as in Autotest. Refer to paragraph 3.1.
4. Press the NEAR-END CROSSTALK key.

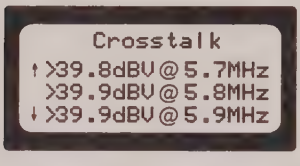


5. Select the Source pair (disturbing) using the right arrow ▶. (See following Note)
6. Select the Test Pair (disturbed) using the up/down arrows ▲▼. (See following Note)

NOTE: Be sure that the SOURCE and TEST pair selections are different. If they are the same, readings will be inaccurately high.

7. Press the ENTER key to begin.

8. When the test is completed, the worst case reading will display on the LCD. All other frequencies can be viewed using the UP or DOWN Arrow keys.



NOTE: *Worst case refers to the point at which the limit was exceeded by the greatest amount or if the pairs passed, the point at which the measurement came closest to the limit without exceeding it.*

9. To obtain a graph printout of crosstalk over frequency, you must output to a printer or PC before running another test. Graphic results cannot be stored in LANTech's memory. Refer to Section 5 for detailed printing and PC download instructions.

Error Messages

>60 dB @ XX.X MHz
Indicates no measurable near-end crosstalk.

<20 dB @ XX.X MHz
A very high level of near-end crosstalk was measured. A split pair condition usually causes this, or loosely twisted cable such as flat silver satin.

4.8 Auxiliary Functions

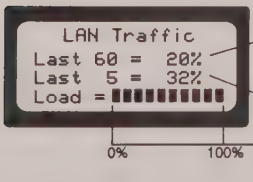
4.8.1 LAN Traffic Monitor

Procedure (10BASE-2, 10BASE-5, 10BASE-T, or ARCNET)

1. Select 10BASE-2, 10BASE-5, 10BASE-T, or ARCNET cable type.
2. Verify connection to a live network.

NOTE: For 10BASE-T LANs, LANTech must be installed in parallel with an active workstation using a line splitter. Refer to Section 9 for accessories. For 10BASE-5 LANs, connection can be made using the BNC-N accessory and a coax T.

3. Press AUXILIARY FUNCTION, then press 1 for LAN Traffic.
4. Results will be displayed as a percentage of total usage as shown below.



5. LANTech will automatically save LAN traffic monitoring data for up to 24 hours.

   To obtain a printed time vs. traffic graph at the end of a monitoring period, press Save/Print and select 3 - Print Graphics.

   For more information concerning Save/Print, refer to Section 5. An example is shown in Appendix B, paragraph D.

4.8.2 Propagation Rate (NVP) Test

Range
0.5 – .99c

Termination
OPEN or SHORT

Procedure

1. Obtain a known length of the desired cable. Greater than 50 feet recommended.
2. Connect the cable directly to the LT-100 (no injectors) with an Open or Short at the far end.
3. Press AUXILIARY FUNCTION, then press 2 for PROP RATE.
4. Use the numeric pad to directly enter the length of the attached cable.
5. Select the test pair with the UP or DOWN Arrow keys and press ENTER.
6. Read the calculated Propagation Rate.

Saving/Printing/Displaying

Upon completion of an Autotest or a Diagnostic Mode test, you may save or print the results if you desire. LANTech will store up to 150 test records (Autotests, Quick Tests, and Diagnostic tests in any combination) internally. Printed output can be graphical, text based, or comma separated variable (CSV) for direct download to a database or spreadsheet program.

Refer to Appendix B for sample printouts from LANTech. Refer to Appendixes D and E for Save/Print flow diagrams.

5.1 Keyboard Functions

UP and DOWN Arrows
Used to select alpha and numeric characters for identifying saved test results.

RIGHT Arrows
In Tag Entry, advances the cursor one space to the right.

LEFT Arrows
In Tag Entry, moves cursor one space to the left. If at the extreme left, cancels the current save operation and returns the user to the test results display.

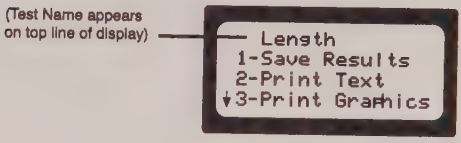
ENTER key
Executes the save with the displayed Tag.

Numeric keys
Enters a number into the Tag and advances the cursor one space to the right.

5.2 Saving Test Results

Procedure

1. Complete an Autotest, Quick Test, or Diagnostic test.
2. Press the SAVE/PRINT key.



3. Press 1 to Save Results.
4. Use the up/down arrows ▲▼, or Numeric keys to enter a Tag (label) for this test. Hold down either arrow key to scroll more quickly.
5. Use left/right arrows to move to another character in the Tag field. Press the ENTER key to execute the save, or use the left ◄ arrow key to exit without saving results.

If the Tag ends in a number, that value will be automatically incremented for the next "save."

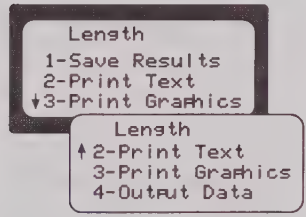
For example, if the prior test was saved as "OFC 24", the next save will be incremented to "OFC 25." The user may change the name if desired prior to saving or press 1 to accept the incremented tag as the saved name.

NOTE: *Tag names can be up to 13 characters long and consist of any alphanumeric symbol plus other keyboard symbols, e.g., . , / ; * + @ # $ % < >.*

5.3 Printing Test Results Directly

Procedure

1. Complete desired Diagnostic Mode test or Autotest.
2. Press the SAVE/PRINT key.



3. Make sure your printer is turned on and connected to LANTech.
4. Select the type of printing suitable for your application:

   - PRINT TEXT – Prints ASCII output of Diagnostic test or Autotest results to any serial RS-232 device. Press the 2 key to execute.
   - PRINT GRAPHICS – Prints graphic plot of diagnostic Attenuation or Near-end Crosstalk results to an EPSON™ compatible printer (PTR-1).

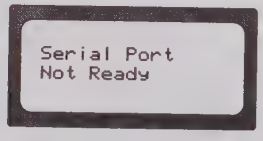
     Also sends graphic plot of Attenuation and NEXT, as well as other test results to an MS-DOS PC through the RS-232 port.

     Requires optional TMTVIEW software. Follow instructions provided with TMTVIEW software. Press the 3 key to execute.

- OUTPUT DATA – Sends text data out of the RS-232 serial port with information (test results and limits) separated by comma delimiters for simplified importation into a spreadsheet or database program. Press the 4 key to execute.

NOTE: Graphic plots of Attenuation and NEXT test data cannot be stored in memory. Transfer of graph results must occur after a test completion and before another test is started.

Error Messages



- Check to see that your printer is powered on and in an on-line state with no error condition existing.
- Check cable for correct type and proper connection at both ends.

Cable Type	Printer Type
LT-PTRC-1	PTR-1 Printer
LT-PTRC-2	Other Serial Printers

NOTE: Also refer to Appendix C for cable printouts.

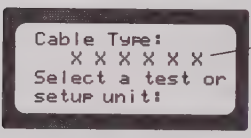
5.4 Saved Data Records Management

Once test results have been tagged and saved they become a sequentially stored set of records. The record sequence in memory is the same order in which the records were stored.

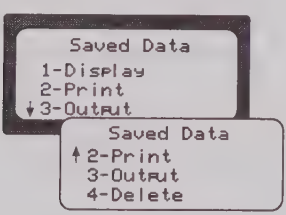
The four options in the Saved Data menu permit you to easily manage those records and choose how and when they will be transferred to a permanent record or deleted.

Preliminary Procedure

A. Press left arrow until display shows the top-level menu:



B. Press SAVE/PRINT Key:



C. Select the operation you wish to perform by pressing the 1, 2, 3, or 4 numeric key.

1 - Display the test record(s) and results on the LCD.
2 - Print the test record(s) to a serial printer.
3 - Output the csv test record(s) data to a PC database or spreadsheet.
4 - Delete* the test record(s) from memory.

CAUTION: ****This is a permanent delete with no recovery possible. Option 2 or 3 should be completed and verified before choosing and executing a delete function.***

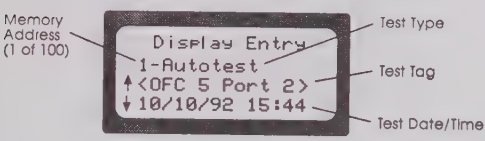
5.4.1 Display

This option will start by displaying the first sequential test result record and permits you to easily scan through all the records using the up and down arrows.

When the desired record is found, press the ENTER key to examine the test results for that record on the LCD.

Procedure

1. Press the 1 key for Display.



2. Use the down arrow to sequence to higher numbered records and the up arrow to lower numbered records. When the down or up arrow indicator on the LCD disappears, there are no more records in that direction of the sequence.

3. When the record of interest is located, press ENTER to display the test results for that record. Test result displays appear in the same format as covered previously in this manual. Refer to the applicable diagnostic test section or the Autotest section.

5.4.2 Print

The Print option enables the user to select one or all records for printing to a serial printer. The output data is in ASCII format sent via the RS-232 port on the LANTech to the serial printer port using an AT-to-Modem cable.

A form feed will follow each test record whether printing directly or from stored test records. Wavetek part numbers for the cable and printer are:

LT-PTRC-1 One AT-to-Modem Cable with DB-9 to DB-25 connectors

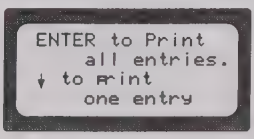
PTR-1LT Compact portable battery operated thermal printer which comes complete with LT-PTRC-1.

Procedure

1. Connect LANTech to the serial printer via the RS-232 port.

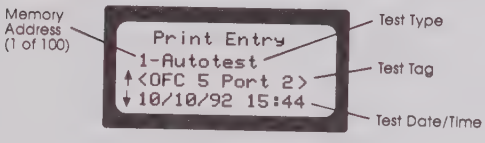
2. Ensure printer is powered on and "on-line." Printer set-ups should be for EPSON logic, 80 column mode, and BAUD rate must be the same as set in the LANTech (Default is 9600). Refer to paragraph 1.9.3 concerning BAUD rate changes.

3. Press the 2 key for Print, and the following display will appear in the LCD.



4. To print text of all stored entries press ENTER.

5. To select a single test result record for printing, use the up/down arrows to scroll to the desired test, then press ENTER to print the test record.



5.4.3 Output

The Output feature permits downloading one or all of the test records to a PC database or spreadsheet. The records are sent in ASCII format as Comma Separated Variables (csv). This procedure requires your PC to be loaded with a serial communication software and a database or spreadsheet program (e.g., dBase, FoxPro, Excel).

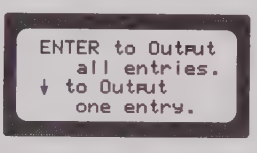
Procedure

1. Connect the LANTech to the COM1 or COM2 port on the PC using a Serial cable. Wavetek's part number for this cable is:

   LT-PC-2 DB-9 to DB-9 Serial cable

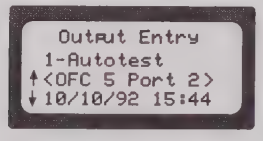
   Set up your serial communication software to download data from the COM port to an ASCII file.

2. Press the 3 key to select Output and the following display will appear in the LCD.



3. To output all stored entries press ENTER.

4. To select a single test result record for output, use the up/down arrows to scroll to the desired test, then press ENTER to output the test record.



5. When download is complete, exit the communications program, load the database or spreadsheet program, and import the ASCII csv data to a prepared database or spreadsheet.

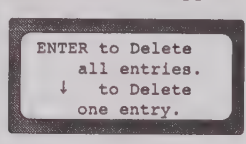
5.4.4 Delete

The delete feature will clear memory of one or all test result records at the user's choice.

CAUTION: *The delete feature has NO recovery or undelete capability. Be absolutely sure required records have been printed or saved to a PC file prior to executing this feature.*

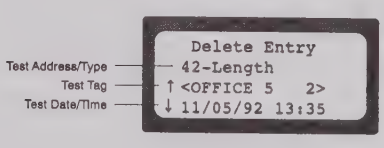
Procedure

1. Press the 4 key to select Delete and the following display will appear in the LCD.



2. To delete ALL stored records press ENTER.

3. To select a single test result record for deletion, use the up/down arrows to scroll to the desired test, then press ENTER to delete the record.



Test Result Interpretation

This section will provide possible causes for some of the failure indications a user may experience while testing cable. An examination will be made from the perspective of a failed Autotest or Quick Test since that involves testing against known values or parameters as specified in the industry. The techniques and possible solutions outlined here can also be used in diagnostic mode testing. For more detailed information on measurement parameters and their impact on cable performance, refer to the Handbook of LAN Cable Testing.

6.1 Cable Length

Cable length problems can usually be divided into two categories. These are (1) cable damage, and (2) incorrect setup information.

Typically, cable damage will result in a much shorter reading and a different type of termination than expected. For example, a cable terminated in a short circuit that is 250 feet (76 meters) long but measures only 135 feet (41 meters) in length with an open termination would be a likely suspect for damage.

Conversely, an expected open that reads as a short is another damage candidate. Overall quality can be tested by measuring length on all pairs to verify that the damage is not only associated with part of the cable.

The other cause of length errors is use of the wrong propagation rate (NVP) set up in the LT-100. Each batch of cable, even of the same type and manufacturer has a slightly different propagation rate.

For absolute accuracy in length measurements, this rate should be measured and loaded prior to making any readings. Refer to the paragraph on PROPAGATION RATE Testing for this procedure.

Some average propagation rates are shown below. These are for information only. The absolute rate for the cable you are testing should be obtained from the cable manufacturer or by testing with the LT-100.

A rule of thumb for NVP error calculation is 2 feet per .01c per 100 feet of cable or 2 meters per .01c per 100 meters of cable. What that means is if the NVP in the LT-100 is 0.65c and your cable's actual NVP is 0.66c, you will measure 98 feet of cable on a 100 foot spool or 98 meters on a 100 meter spool.

Cable Type	Typical NVP
10BASE-5 COAX	.77c
RG-58 COAX	.66c
RG-62 COAX	.84c
CAT 3 UTP	.65c
CAT 4 UTP	.70c
CAT 5 UTP	.73c

6.2 Capacitance

A cable's mutual capacitance can be a quick indicator of overall quality. LANTech measures this value and provides a picofarad/foot (meter) reading in the Autotest mode. In the diagnostic mode, manual calculation is required to arrive at the pF/ft (meter) value.

Due to the length of most cables, normal diagnostic mode capacitance readings are in some quantity of nanofarads. The conversion is 1 nanofarad (nF) = 1000 picofarads (pF). Please refer to the example at the bottom of the page describing the diagnostic mode capacitance test.

Cable manufacturers build their product with a predetermined amount of mutual capacitance. Provided the cable is not stressed excessively during installation, this value is very regular and constant for that particular type of cable.

The EIA/TIA 568 specification provides useful limits on mutual capacitance for data grade unshielded twisted pair cabling. These values are an excellent benchmark when testing existing or newly installed cable for quality.

Capacitance in excess of the published specification indicates that the cable will tend to absorb the transmitted signal and thus limit the maximum length of the cable segment to some value below industry standards.

Unusually low capacitance for a given cable type can be an indicator of a split pair situation and prompts the need for further testing, such as near-end crosstalk to verify.

If you are uncertain as to the specified capacitance for the cable being measured, refer to the manufacturer's catalog (if possible) or the EIA/TIA 568 specification for guidance.

Conversion Example:

A 215 foot cable measures 4.5 nF.

$$\frac{4.5\text{ nF}}{215\text{ ft}} = \frac{4500\text{ pF}}{215\text{ ft}} = 20.93\text{ pF/ft}$$

$$\frac{4.5\text{ nF}}{66\text{ m}} = \frac{4500\text{ pF}}{66\text{m}} = 68.18\text{ pF/meter}$$

Mutual Capacitance Requirements

EIA/TIA Category	Capacitance In pf/ft
3	20
4	17
5	17

The cable in the conversion example above would not qualify as a category 3 (Cat 3) cable.

6.3 Line Map

The LINE MAP is a measure of continuity and connectivity. LANTech makes several sequential measurements on all lines of the RJ-45 modular connector to determine the status of the cable connected. All eight lines are tested each time the line map is run. For Autotest purposes, default pinouts are entered or chosen corresponding to specific topologies. This way, only the lines necessary for the chosen topology affect the pass or fail status while all are reported.

Interpretation of the Line Map involves matching the upper and lower rows of numbers corresponding to the pins in the RJ-45 modular connector. The upper row represents the near-end connector. The lower row shows the status of all eight lines in the RJ-45. The office ID is a number from 1 - 8 found on the optional Intelligent Terminator kit. Office ID detection requires pins 3, 5, and 6 be connected to recognize the pre-programmed numeric value.

For Autotest purposes, the Line Map registers a pass when the required pins as specified by the topology or the user are connected straight through to the far end. A failure would be when any one or several of the required pins are miswired, shorted, or open. Please refer to Section 4 Diagnostic Mode Testing for detailed error messages.

Line Map will also perform a shield test if shielded patch cables are used during the testing. A good shield continuity test is indicated by an "s" to the right of the line map's position 8. The absence of this "s" during a line map test on a shielded system indicates a break in the shield continuity.

Since the patch cable's shield must have continuity for this test to work, it should be tested prior to testing shielded systems. To test the patch cables, connect the LANTech 100 system together in the calibrate AXT-110 and AXT-111 configuration (refer to paragraph 1.9.6).

Add a jumper wire to connect the shielded RJ-45s on either side of the 8MP/8MP Coupler, then run the Line Map. A good line map test will result with the "s" present. If it does not, repair or change the patch cables before conducting further testing.

6.4 Office Identification

LANTech can also help trace unidentified twisted pairs from end destinations (i.e. an office) to the wiring closet. Using optional Intelligent Terminators (IT-2) in place of the AXT-110, up to eight offices can be terminated and the corresponding cables identified at the wiring closet with LINE MAP.

6.5 Average Noise

Average noise is an RMS measurement of induced electrical signals onto the cable or wire pair under test. By isolating the source of noise by frequency, the user may more easily identify that source. Some typical noise generators and their associated active frequency bands are listed in Section 4 of Diagnostic Mode Testing.

Any recorded noise in excess of 150 mV has the potential to cause transmission errors and reduce network performance due to transmission retries.

6.6 Attenuation

The LT-100 measures attenuation and NEXT using a reference signal provided from the AXT-111 NEXT Injector. The level of this signal is referred to as 0 dB. All measurements are negative relative to this value and are expressed in negative decibels (dB). Due to industry convention, the minus (-) sign is dropped and the values are read as whole positive numbers (e.g. -23 dB becomes 23 dB, -14 dB becomes 14 dB, etc.).

Keep in mind that decibel readings are not linear. That is, 4 dB is not twice as much as 2 dB Actually, a difference of 6 dB is twice (or half) the signal strength. Therefore a -16 dB signal would be half the strength of a -10 dB signal.

As a guide, when reading attenuation test results, the closer they are to zero decibels (0 dB), the better. This indicates little loss (attenuation) in the cable being tested. Near-end crosstalk on the other hand should be as far negative from zero as possible indicating little or no induced signal.

Usually linear in its performance, attenuation plots as a gradual curve downward (towards -50 dB) as the test frequency increases. The slope of the curve depends upon the length of cable under test. Higher quality cables will have a more gradual slope to their curves compared to the same length of a lower quality sample.

As a rule of thumb, a cable is a minimum category 3 if it displays 30 dB / 1000 ft. (328 meters) at 10 MHz. This type of cable should also measure less than 11.5 dB at 10 MHz for any segment up to 328 feet (100 meters, IEEE 802.3 10Base-T specification).

Deviations from the above examples include very steep curves, flat spots or dropoffs during the course of the swept measurement. If the printed graph shows a gradual curve with small peaks and valleys, there is most likely an impedance mismatch between the AXT-110 and the cable under test. This is not a significant concern and can be disregarded.

6.7 Near-End Crosstalk (NEXT)

NEXT is very unpredictable in its response curve. Typical graphs show peaks and valleys of NEXT throughout the operating frequency range. Cable stress, position, and integrity of interconnecting components all contribute to the frequency and amplitude of these peaks and valleys. The twist and lay of the cable under test absolutely determines the susceptibility of that cable or cable segment to near-end crosstalk. Untwisted cable such as silver satin or some RS-232 terminal cables exhibit high crosstalk readings.

Unlike attenuation measurements, when reading NEXT results, the larger the negative decibel value the better. Since our input to the adjacent pair is 0 dB, the most desirable measured NEXT is as far from zero as possible.

It is highly advised to avoid use of RJ-45 female/female couplers in connecting cables being tested for NEXT. These couplers can induce severe amounts of crosstalk at higher frequencies.

6.8 D.C. Resistance

The loop resistance measurement is the sum of the resistance of both conductors in a pair of wires or the combination of the center conductor and shield in a coaxial cable. This measured value increases linearly along with the length of the cable. For the most common lengths of cable found in LAN applications (less than 100 meters), this value will rarely exceed the 20Ω default limit. If the cable segment under test is significantly longer or of lower quality, this limit may need to be raised. Under no circumstances should the measured D.C. loop resistance exceed 150Ω for communications cable 2000 ft. or less in length.

Variations from the above guidelines are typically indicative of a poor connection at a punch-down, wall plate, or modular plug.

6.9 Transient Noise

Transient or impulse noise can cause intermittent problems with a wide variety of symptoms. The most difficult aspect of transient interpretation is ruling out signals that are supposed to be there. This can easily be done by selecting an appropriate threshold voltage level. Once this is accomplished, LANTech will disregard measured signals below and only record those occurrences exceeding the threshold. Typical threshold settings range from 260 mV (10 Base-T) up to 1.5V (1500 mV).

If a printer is attached, the date and time of the impulse's occurrence will be recorded. This can prove invaluable in troubleshooting an intermittent problem.

6.10 LAN Traffic Monitor

The traffic monitor will provide an indication of network usage to assist the user in assessing the load on their system. Readings are in percent with 100% being continuous traffic. Any reading over 30% continuously is indicative of a problem or a need to split the network into more than one physical unit.

Service Information

7.1 Service Returns In the United States

Any LT-100 returned for repair should be shipped with the following information and items:

- Company Name (if applicable), your name, address, phone number, proof of purchase (for warranty repairs), and a description of the particular service required. Use the guidelines below to repack the unit with commercially-available materials if the original packing materials are not available:
- Wrap the instrument in heavy paper or plastic.
- Use a strong shipping container. A double-walled carton of 250-pound test material is adequate.
- Use a layer of shock-absorbing material 70 to 100 mm (3 to 4 inches) thick around all sides of the instrument to provide firm cushioning and to prevent the unit from moving inside the container. Protect the control panel with cardboard.
- Seal the shipping container securely.
- Ship the LT-100 (with the AXT-110 and AXT-111) with shipping charges prepaid to:

  Wavetek Corporation
  9045 Balboa Avenue Suite A
  San Diego, CA 92123
  ATTN: Instrument Repair/Service

The LT-100 will be returned with the shipping charges paid by Wavetek Corp. For questions in North America, please call the Instrument Repair & Service Department at 1-800-223-9885.

7.2 Service Returns Outside the United States

In the European and International geographies, any service return should be arranged directly with your immediate local supplier (national distributor or subsidiary). They will, where necessary, arrange local service or service at Wavetek's European or North American Service Centers. Be certain to follow the packing instructions given in this manual.

Specifications

8.1 Electrical Specifications

Normal operating temperature range is 20 - 30°C

Line Map:
3- to 8-wire pin connectivity and cable destination; shows shorts, opens, combined shorts/opens, swaps, shield continuity, and office identification.

Length:

Twisted Pair

Range:	18 to 2000 ft (5.5 to 610 m)
Accuracy:	±(4% + 4 ft/1.2 m) ±nvp uncertainty.
Resolution:	1 foot (0.1 meter)

Coax:

Range:	18 to 3000 ft (5.5 to 610 m)
Accuracy:	±(4% + 4 ft/1.2 m) ±nvp uncertainty.
Resolution:	1 foot or 0.1 meter

DC Resistance:

Ranges:	5, 0-50 kΩ, autoranging
Accuracy:	±1% + 3 counts
Max. Resolution:	0.1Ω

Capacitance:

Ranges:	4, 0-100 nF, autoranging
Accuracy:	±5% + 5 counts
Max Resolution:	1 pF

Average Noise:

Range:	0-2000 mV RMS	
Bands:	Low	40 Hz - 150 kHz
	Mid	40 Hz - 20 MHz
	High	20 MHz - 100 MHz

Transient (impulse) Noise:

Variable Threshold:	0-2000 mV
Resolution:	1 mV
Max Counts:	9999 per Second

Attenuation:

Swept Frequency Range:	500 kHz to 100 MHz in 300 total frequency steps, 100 per decade, logarithmic increments.
Dynamic Range:	0 to -50 dB
Resolution:	0.1 dB
Accuracy:	±2 dB

Near-End Crosstalk (NEXT):

Swept Frequency Range:	100 kHz to 100 MHz in 300 total frequency steps, 100 per decade, logarithmic increments.
Dynamic Range:	-10 to -60 dB
Resolution:	0.1 dB
Accuracy:	±2 dB

LAN Traffic Monitor:

Percent Utilization:	0 to 100%
Accuracy:	±1%

Temperature Coefficient: Specified accuracy ±0.1 x specified accuracy / °C from 0 - 20°C and 30 - 50°C

Propagation Rate:
Automatically set for each cable type, or may be "learned" from known cable length, in range 0.50c to 0.99c (nvp).

8.2 General Specifications

Memory: Stores 150 Autotest, Quick Test, or diagnostic test results under User-programmable names.

Cable Memory: 20 cable types with factory programmed default values individually modifiable. Storage for 9 customized user tagged entries.

Keyboard: 28-key tactile keyboard with function keys and numeric keys for direct number entry.

Display: 4-line x 16-character LCD, menu driven selection

Operating Temp: 0 to +50°C, +32 to +122°F.

Storage Temp: -15 to +70°C, +5 to +158°F.

Humidity: 5 to 90% RH noncondensing

Power:

LT-100: Internal 650 mA slow charge Ni-Cad batteries included (recharge time of 12-15 hours). Up to 5 hours operation typical. Unit will also operate during recharge. External power supply a wall mount 9V @ 1000 mA with center negative.

AXT-110: 7.2V Rechargeable Nicad battery, Up to 5 hours operation typical. Unit will also operate during recharge. External power supply is a wall mount 9V @ 1000 mA with center negative.

AXT-111: 7.2V Rechargeable Nicad battery, Up to 5 hours operation typical. Unit will also operate during recharge. External power supply is a wall mount 9V @ 1000 mA with center negative.

Dimensions:

LT-100: 21 cm (8.3") H x 10 cm (3.9") W x 4 cm (1.4") D

AXT-110: 4 cm (1.5") H x 14 cm (5.5") W x 22 cm (8.75") D

AXT-111: 4 cm (1.5") H x 14 cm (5.5") W x 22 cm (8.75") D

Weight:

LT-100: Approx. 636 gm (1.4 lb)

AXT-110: Approx. 815 gm (1.8 lb)

AXT-111: Approx. 680 gm (1.5 lb)

8.3 Serial Port Pin Assignments

Type: RS-232

Connector: DB-9

Pin	Signal
1	Not Connected
2	RXD - Receive Data (Input)
3	TXD - Transmit Data (Output)
4	DTR - Data Terminal Ready (Output)
5	GND - Ground
6	Not Connected
7	Not Connected
8	CTS - Clear To Send (Input)
9	Not Connected

8.4 Data Stream Information

Data Length: 8 bits, no parity

Start/Stop Bit: 1/1

Speed: 300 to 9600 BAUD User Selectable

Control: XON/XOFF and CTS.

Selectable graphic, text, or csv output (for database or spreadsheet) to PC or printer. Printer requires EPSON "ESC L" graphics ability for graphical printout (e.g., PTR-1 or Epson FX compatible).

Optional Cable Adapters, Printers, and Accessories

(Not included with the LANTech 100)

Part Number	Description
BA-BIX	Block adapter, Northern Telcom BIX wiring block to RJ-45 female.
BA-66	Block adapter, M66 wiring block to RJ-45 female.
BA-110	Block adapter, M110 wiring block to RJ-45 female.

NOTE: At time of publication, the only block adapters available are rated to Category 4 maximum. Consult your local distributor for current information on all adapters.

BNC-BNCF	BNC Barrel connector
BNC-N	Set of two BNC male to N female adapters.
BNC-50/S	Dual BNC connector, 50Ω/ Shorting

NOTE: The BNC accessories listed above are available together in CX-KIT.

CA-8MP-100	Set of two 3-foot patch cables (RJ-45 to RJ-45) and one F/F coupler.
CA-8MJ-DUAL	One 8MP split to two 8MJ jacks wired in parallel.
CA-IBM-CAT5	Set of two enhanced IBM Token Ring adapters with Type A to DB25 cables. For LANTech 100 only.
CA-STP-100	Set of shielded patch cables for testing shielded CAT 5 systems. *For LANTech 100 only.*

CA-TWIN	Cable adapter set for TWINAX systems..
CA-UTP-100	Set of replacement unshielded patch cables. *For LANTech 100 only.*
CX-ATN	Coax to RJ-45 female adapter. *Two are required for performing coax attenuation testing.*
DCC-LT100	Deluxe hard-sided carrying case for LANTech 100, PTR-1LT, patch cables, and accessories.
H-LT100	Protective holster for the LT-100 hand held unit..
IT-2	Set of eight Intelligent Terminators/Office Identifiers.
LT-PC-2	Serial interface cable with DB9 female to DB9 females for PC connections. Available FREE with submission of the warranty card in the front of this manual.
LT-PTRC-1	Serial printer interface cable with DB9 female to DB25 male connections.
PTR-1LT	Portable, battery operated, thermal printer with battery charger/eliminator and LT-PTRC-1 cable included.
PTR-PPR	Three extra paper rolls for PTR-1LT.
SCA-8MP-CAT5	Two 1 meter STP cable adapters, 8MP/8MP.
SCC-LT100	Soft Carrying Case for LANTech 100, PTR-1LT, patch cables, and accessories.

See your local distributor for pricing and availability of products.

Configuration Default Table

NOTE: Cables are listed in "Cable Type" menu order. Cable parameters are listed in "Custom Cable" menu orderCable Configuration Defaults

Custom Cable Group	Menu Item= Cable Type	1 NVP Prop. Rate (% C)	2 Atten/NEXT Range Start - Stop MHz - MHz	3 Pin Usage (Shown in Pairs)	4 Max Loop Res. (Ohms)	5 NEXT Limit at Max Freq. (dB)	6 Attenuation Limit at Max Freq. (dB)	7 Length Max ft/m	8 Max Capaci-tance pFft - pF/m	9 ACR Min. (dB)
Ethernet	10BASE-T	0.65	0.1 - 10.0	3,6 1,2	20.0	26.0	10.5	328/100	20/66	10
	10BASE-2	0.66	0.1 - 10.0	BNC	20.0	N/A	8.5	607/185	29/95	N/A
	10BASE-5	0.78	0.1 - 10.0	BNC	20.0	N/A	8.5	1640/500	26/85	N/A
Token Ring	16MB on UTP	0.71	0.1 - 16.0	3,6 4,5	20.0	38.0	22.0	328/100	17/56	13
	4MB on UTP	0.65	0.1 - 4.0	3,6 4,5	20.0	32.0	16.0	328/100	20/66	13
	16MB on STP	0.78	0.1 - 16.0	3,6 4,5	35.0	32.0	15.0	328/100	9/30	13
	4MB on STP	0.78	0.1 - 4.0	3,6 4,5	35.0	23.0	8.0	656/200	9/30	13
Twisted Pair	Cat 2	0.65	0.1 - 10.0	3,6 1,2 4,5 7,8	20.0	N/A	10	328/100	20/66	N/A
	EIA/UL Cat 3	0.65	0.7 - 16.0	3,6 1,2 4,5 7,8	20.0	19.3	14.6	328/100	20/66	10
	EIA/UL Cat 4	0.71	0.7 - 20.0	3,6 1,2 4,5 7,8	20.0	31.4	11.0	328/100	17/56	13
	EIA/UL Cat 5	0.75	0.1 - 100	3,6 1,2 4,5 7,8	20.0	27.1	23.6	328/100	17/56	7.0
	TP-DDI	0.75	0.1 - 100	1,2 7,8	20.0	27.1	23.6	328/100	17/56	5.0
Misc.	Localtalk	0.65	0.1 - 1.0	3,6	20.0	N/A	10	328/100	20/66	N/A
	ISDN	0.65	0.1 - 1.0	3,6 4,5	40.0	N/A	10	1066/325	20/66	10
	Single Pair	0.65	0.1 - 1.0	4,5	20.0	N/A	10	328/100	20/66	N/A
	USOC	0.65	0.1 - 1.0	3,6 4,5	65.0	N/A	10	2034/620	20/66	10
	IBM Coax	0.84	0.1 - 10.0	BNC	20.0	N/A	10	2034/620	14/46	N/A
	TWINAX	0.66	0.1 - 10.0	BNC	20.0	N/A	10	2034/620	16/52	N/A
	ARCNET	0.84	0.1 - 10.0	BNC	20.0	N/A	10	2034/620	14/46	N/A
	CATV	0.66	0.1 - 10.0	BNC	20.0	N/A	10	2034/620	21/69	N/A

Sample Printouts

A. Test results from AUTOTEST when "All Tests Passed" printed directly (Refer to Section 5.3)

WAVETEX LANTech 100
Autotest

Cable Type = EIA/UL Cat 5
Prop Rate = 0.75c
Frequency = 0.1 - 100.0MHz

Pins: 12345678
Line Map: 12345678 Office ID = A
Limit: 12345678

Crosstalk
3,6 =) 1,2: >60.dB at 1.99MHz Limit: 55.0dB
1,2 =) 4,5: 33.4dB at 85.1MHz Limit: 28.4dB
4,5 =) 7,8: 30.3dB at 89.1MHz Limit: 28.0dB
7,8 =) 3,6: >60.dB at 2.14MHz Limit: 55.0dB
3,6 =) 4,5: 35.7dB at 38.9MHz Limit: 34.1dB
1,2 =) 7,8: >60.dB at 1.51MHz Limit: 55.0dB

	Loop Res.	Attenuation	Length	Capacitance	ACR
Limits:	20.0ohms	23.6dB	328ft	17.pF/ft	7.0dB
3,6:	16.1ohms	16.7dB at 97.7MHz	306ft	14.pF/ft	13.5dB
1,2:	15.9ohms	16.6dB at 95.5MHz	306ft	15.pF/ft	16.8dB
4,5:	15.5ohms	16.0dB at 95.5MHz	301ft	14.pF/ft	14.2dB
7,8:	15.6ohms	16.6dB at 95.5MHz	299ft	14.pF/ft	13.6dB

All Tests Passed

_____ 01/13/94 20:04
Operator

_____
Reference

NOTE: Crosstalk Limits. On test pairs that pass, the limit is printed at the corresponding frequency where the measured crosstalk came closest to the limit.

Test results from AUTOTEST when one limit was exceeded (note the asterisk) printed directly (Refer to Section 5.3)

```
                                WAVETEX LANTech 100
                                    Autotest

Cable Type  = EIA/UL Cat 5
Prop Rate   = 0.75c

Pins:     12345678
Line Map: 12345678      Office ID = A
Limit:    12345678

Loop Res.   = 11.3ohms
Limit:        20.0ohms

        Crosstalk
3,6 ==> 1,2: 32.1dB at 65.1MHz   Limit: 30.3dB
1,2 ==> 4,5: >60.dB at  1.0MHz   Limit: 55.0dB
4,5 ==> 7,8: 30.5dB at 98.7MHz   Limit: 27.2dB
7,8 ==> 3,6: 29.0dB at 92.2MHz   Limit: 27.8dB
3,6 ==> 4,5: 25.7dB at 80.3MHz * Limit: 28.9dB
1,2 ==> 7,8: >60.dB at  0.9MHz   Limit: 55.0dB

      Attenuation              Length     Capacitance     SNR
Limits: 23.5dB                 328ft      17.pF/ft        5.0dB
   3,6: 16.0dB at 99.5MHz      273ft      14.pF/ft        9.7dB
   1,2: 15.3dB at 96.5MHz      277ft      14.pF/ft       16.8dB
   4,5: 14.6dB at 81.0MHz      275ft      13.pF/ft       11.1dB
   7,8: 14.9dB at 81.5MHz      270ft      14.pF/ft       15.6dB

                              * Limit Exceeded


_____ 07/29/93 13:34
Operator

_____
Reference
```

NOTE: Crosstalk Limits. On the test pairs that fail, the limit printed is at the corresponding frequency to the failure excursion's peak.

With the ACR method, if a crosstalk limit exceeds the EIA/TIA Model by less than 7 dB and ACR is a pass, an asterisk will appear next to the exceeded limit, but "All Tests Pass" will appear on the printout. Exceeding any crosstalk by 7 dB or more, exceeding any other parameter limit or having any ACR out of limit will cause "• Limit Exceeded" to print at the end of test.

Test results from Quick Test when "All Tests Passed" printed directly (Refer to Section 5.3)

WAVETEK LANTech 100
Diagnostic Quick Test Summary

Cable Type = EIA/UL Cat 5
Prop Rate = 0.75c
Frequency = 0.1 - 100.0MHz

Pins: 12345678
Line Map: 12345678 Office ID = A
Limit: 12345678

Crosstalk

3,6 =>) 1,2: >60.dB at 2.09MHz Limit: 55.0dB
1,2 =>) 4,5: >60.dB at 1.91MHz Limit: 55.0dB
4,5 =>) 7,8: 30.9dB at 83.2MHz Limit: 28.5dB
7,8 =>) 3,6: >60.dB at 2.09MHz Limit: 55.0dB
3,6 =>) 4,5: 36.0dB at 36.3MHz Limit: 34.6dB
1,2 =>) 7,8: >60.dB at 1.91MHz Limit: 55.0dB

	Loop Res.	Attenuation	Length	Capacitance	ACR
Limits:	20.0ohms	23.6dB	328ft	17.pF/ft	7.0dB
3,6:	16.2ohms	16.6dB at 100.MHz	306ft	14.pF/ft	13.4dB
1,2:	16.0ohms	16.5dB at 100.MHz	306ft	15.pF/ft	22.3dB
4,5:	15.5ohms	16.0dB at 75.9MHz	302ft	14.pF/ft	14.0dB
7,8:	15.6ohms	16.6dB at 75.9MHz	299ft	14.pF/ft	14.3dB

All Tests Passed

_____ 01/13/94 20:03
Operator

_____
Reference

NOTE: Crosstalk Limits. On the test pairs that pass, the limit is printed at the corresponding frequency where the measured crosstalk came closest to the limit.

Attenuation and Diagnostic Crosstalk Graphs

(Refer to the Attenuation and Crosstalk graphs on the following pages)

The graph's frequency divisions are spaced in the logarithmic pattern representative of the logarithmic points of measurement.

The dots represent exact measurement points in frequency and the resulting dB reading at that frequency.

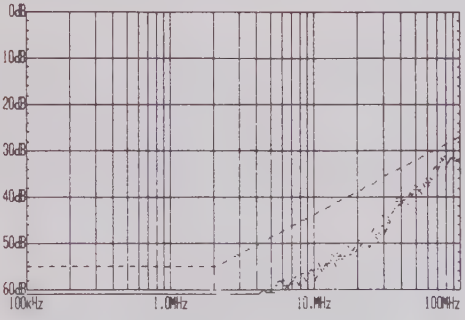
The dashed line represents the frequency and dB limits set on the instrument at the time of testing. Altering the frequency limits for Attenuation or Crosstalk will cause the corresponding limit line to lengthen or shorten. Altering dB pass limits will alter the entire limit line's position on the graph.

In the Crosstalk graph, this limit line is a slope per EIA/TIA formula, but is flattened at 55 dB to maintain a practical 5 dB separation from the limit floor. The slope's length and position on the graph is calculated from the highest frequency limit and pass dB limit settings. If you change either limit, the entire slope will move accordingly. This change will also relocate the intersect point at the 55 dB line.

B. Test result from NEXT test printed directly: PRINT GRAPHICS (Refer to Section 5.3)

WAVETEX LANTech 100
Diagnostic Crosstalk Summary

Cable Type = EIA/IL Cat 5
Test Pair = 3,6
Source Pair = 1,2



Crosstalk = 31.6dB at 74.1MHz

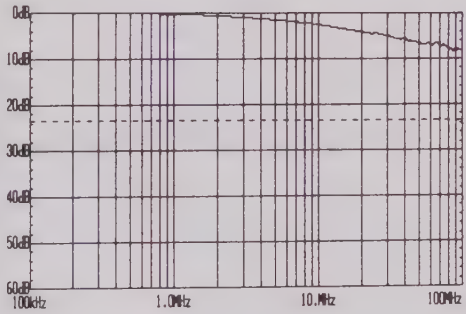
_____ 10/10/92 00:26
Operator

_____
Reference

C. ATTENUATION test results printed directly: PRINT GRAPHICS (Refer to Section 5.3)

WAVETEK LANTech 100
Diagnostic Attenuation Summary

Cable Type = EIA/UL Cat 5
Test Pair = 3,6



Attenuation = 8.7dB at 87.1MHz

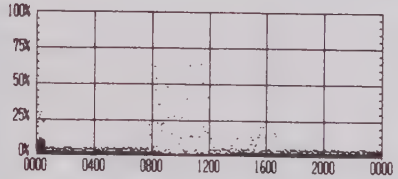
_____ 10/15/92 02:02
Operator

_____
Reference

D. LAN Monitoring test result printed directly after 24 hours: PRINT GRAPHICS (Refer to Section 5.3)

WAVETEK LANTech 10
Diagnostic LAN Traffic Summary

Cable Type = 10BASE-2
Test Pair = BNC



05/13/93 16:46
Operator

Reference

E. AVERAGE NOISE test results printed directly (Refer to Section 5.3) or from memory (Refer to Section 5.4)

```
----------------------------------------
          WAVETEK LANTech 100
      Diagnostic Avg. Noise Summary

Cable Type  = EIA/UL Cat 4
Test Pair   = 3,6

Avg. Noise  =     1mV
Band        =  20MHz


_____                    03/19/93 12:53
Operator

_____
Reference

----------------------------------------
```

F. LENGTH test results printed directly (Refer to Section 5.3) or from memory (Refer to Section 5.4)

```
----------------------------------------
          WAVETEK LANTech 100
      Diagnostic Length Summary

Cable Type  = EIA/UL Cat 4
Test Pair   = 3,6

Length      = Open   at  101ft
Prop Rate   = 0.71c


_____                    10/10/92 00:00
Operator

_____
Reference

----------------------------------------
```

G. TRANSIENT NOISE test results printed directly (Refer to Section 5.3)

WAVETEK LANTech 100
Diagnostic Transient Noise Summary

Cable Type = 10baseT
Test Pair = 1,2

1453 Counts at 11:10:38
1205 Counts at 11:10:43
1452 Counts at 11:10:45
1208 Counts at 11:11:06
655 Counts at 11:11:12
1033 Counts at 11:11:14

422 Counts at 12:03:21
1454 Counts at 12:03:44
1188 Counts at 12:03:45
1189 Counts at 12:03:46
104 Counts at 12:03:52
1253 Counts at 12:05:15
788 Counts at 12:05:18
1455 Counts at 12:05:18
1177 Counts at 12:05:19
1222 Counts at 12:05:19
1455 Counts at 12:05:21
1308 Counts at 12:05:21
899 Counts at 12:05:21
1100 Counts at 12:05:22
1212 Counts at 12:05:22
1133 Counts at 12:05:23
554 Counts at 12:05:24
1004 Counts at 12:05:24
600 Counts at 12:05:25
1034 Counts at 12:05:30

03/16/93 13:27

Operator

Reference

LANTech-100 Printer and PC Connection Information

Since there are a variety of LANTech 100 to serial printer or PC connections possible, the technical manual supplied with your brand and model printer or PC should be consulted for specific information on the serial port's communications protocol. Refer to Section 8 in this manual for LANTech's RS-232C signal and pin configurations. The following are general guidelines on serial port cables and wiring configurations.

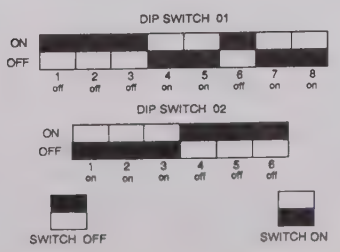
A. If you order Wavetek's PTR-1LT printer, the interconnection cable LT-PTRC-1 is included.

B. If you have a PTR-1 printer (ordered with a TMT-1) and wish to use this printer with your LANTech 100, you will need the LANTech's serial cable accessory LT-PTRC-1 cable or equivalent as shown below:

AT-to-Modem Cable

LANTech (DCE) DB9 Female		PTR-1 (DCE) DB25 Male
2	———	3
3	———	2
4	———	20
5	———	7
8	———	5

In addition, with LANTech 100 Ver 2.0, ensure the PTR-1 dip switches are set as follows:



C. Most other serial printers are configured as Data Terminal Equipment (DTE) which requires the wiring configuration listed below.

Cable

LANTech (DCE) DB9 Female		Printer (DTE) DB25 Male
2	———	2
3	———	3
4	———	20
5	———	7
8	———	5

D. If you are connecting the LANTech 100 to a PC serial port (COM1 or COM2), use one of the following cable configurations as required to support your PC serial port:

Cable

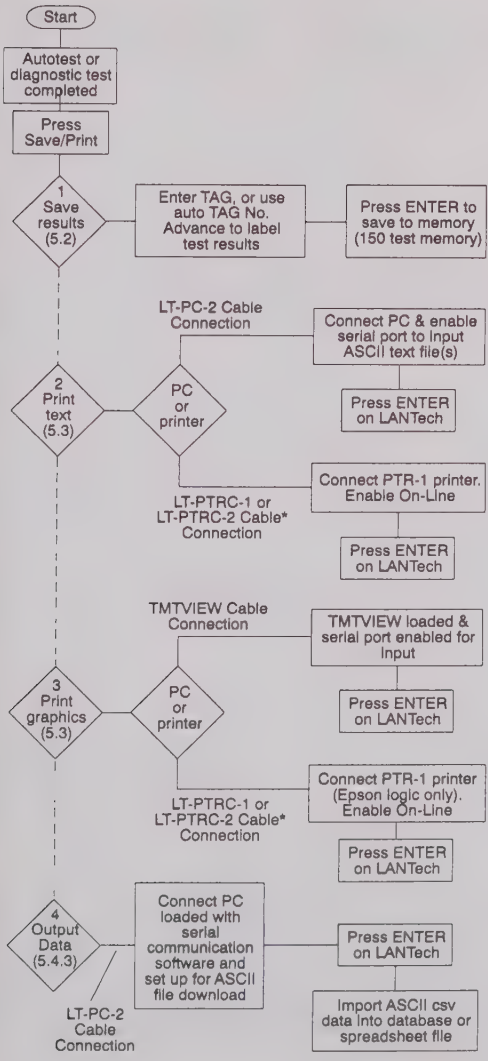
LANTech (DCE) DB9 Female		IBM-PC (DTE) DB25 Male/Female
2	———	2
3	———	3
4	———	5
5	———	7
8	———	20

Cable

DB9 Female		IBM-AT DB9 Male/Female
2	———	3
3	———	2
4	———	8
5	———	5
8	———	4

NOTE: Pin numbers not shown are not connected.

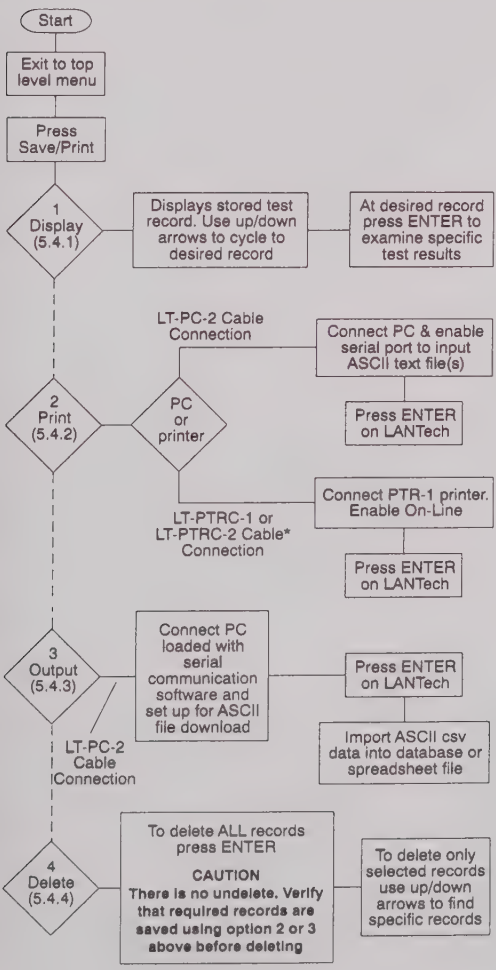
Test Result Save/Print Options


Start
Autotest or diagnostic test completed
Press Save/Print
1 Save results (5.2)
Enter TAG, or use auto TAG No. Advance to label test results
Press ENTER to save to memory (150 test memory)
2 Print text (5.3)
PC or printer
LT-PC-2 Cable Connection
Connect PC & enable serial port to input ASCII text file(s)
Press ENTER on LANTech
LT-PTRC-1 or LT-PTRC-2 Cable* Connection
Connect PTR-1 printer. Enable On-Line
Press ENTER on LANTech
3 Print graphics (5.3)
PC or printer
TMTVIEW Cable Connection
TMTVIEW loaded & serial port enabled for input
Press ENTER on LANTech
LT-PTRC-1 or LT-PTRC-2 Cable* Connection
Connect PTR-1 printer (Epson logic only). Enable On-Line
Press ENTER on LANTech
4 Output Data (5.4.3)
LT-PC-2 Cable Connection
Connect PC loaded with serial communication software and set up for ASCII file download
Press ENTER on LANTech
Import ASCII csv data into database or spreadsheet file

** If you are using a serial printer other than PTR-1, use the LT-PTRC-2 cable supplied with your LANTech 100. Refer to Section 8.3 and your own printer manual to match RS-232 port protocol.*

Saved Records Management

NOTE: Manual paragraph references are given in parenththeses.


Start
Exit to top level menu
Press Save/Print
1 Display (5.4.1)
Displays stored test record. Use up/down arrows to cycle to desired record
At desired record press ENTER to examine specific test results
2 Print (5.4.2)
PC or printer
LT-PC-2 Cable Connection
Connect PC & enable serial port to input ASCII text file(s)
Press ENTER on LANTech
LT-PTRC-1 or LT-PTRC-2 Cable* Connection
Connect PTR-1 printer. Enable On-Line
Press ENTER on LANTech
3 Output (5.4.3)
Connect PC loaded with serial communication software and set up for ASCII file download
Press ENTER on LANTech
Import ASCII csv data into database or spreadsheet file
LT-PC-2 Cable Connection
4 Delete (5.4.4)
To delete ALL records press ENTER
CAUTION
There is no undelete. Verify that required records are saved using option 2 or 3 above before deleting
To delete only selected records use up/down arrows to find specific records

** If you are using a serial printer other than PTR-1, use the LT-PTRC-2 cable supplied with your LANTech 100. Refer to Section 8.3 and your own printer manual to match RS-232 port protocol.*

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